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CONTRIBUTORS TO THIS NUMBER

ASTLEY P. C. ASHHURST, M. D., Associate in Surgery, University of Pennsylvania; Surgeon to the Episcopal Hospital and to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases.

JOHN G. CLARK, M. D., Professor of Gynecology, University of Pennsylvania; Gynecologist, University Hospital.

J. CHALMERS DA COSTA, M. D., Samuel D. Gross Professor of Surgery, Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital; Surgeon to St. Joseph's Hospital.

JOHN B. DEAVER, M. D., John Rhea Barton Professor of Surgery, University of Pennsylvania; Surgeon in Chief, Lankenau Hospital.

CHARLES H. FRAZIER, M. D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon, University Hospital.

JOHN H. GIBBON, M. D., Professor of Surgery, Jefferson Medical College; Surgeon to the Pennsylvania and Jefferson Hospitals.

JOHN H. JOPSON, M. D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Presbyterian, the Childrens', and the Bryn Mawr Hospitals; Consulting Surgeon to the Philadelphia Home for Incurables.

WILLIAM WILLIAMS KEEN, M. D., Emeritus Professor of Surgery, Jefferson Medical College.

GEORGE P. MULLER, M. D., Professor of Surgery, Graduate School, University of Pennsylvania; Surgeon to St. Agnes and Misericordiæ Hospitals.

CHARLES F. NASSAU, M. D., Assistant Professor of Surgery, Jefferson Medical College; Assistant Surgeon, Jefferson Medical College Hospital; Surgeon to St. Joseph's and Mt. Sinai Hospitals; Chief Surgeon, Frankford Hospital.

T. TURNER THOMAS, M. D., Associate in Surgery and Associate Professor of Applied Anatomy, University of Pennsylvania; Associate Professor of Surgery and Applied Anatomy in the Post-Graduate School of the University of Pennsylvania; Surgeon to the Philadelphia General Hospital; Surgeon-in-Chief to the Northeastern Hospital.

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INTRODUCTION TO THE SURGICAL CLINICS OF NORTH AMERICA

BY

W. W. KEEN, M.D., LL.D.,

EMERITUS PROFESSOR OF SURGERY, JEFFERSON MEDICAL COLLEGE, PHILADELPHIA

It is most appropriate that the initial volume of the "Surgical Clinics of North America" should be the Philadelphia number, for Philadelphia was the first to employ this method of instruction in the Jefferson, the University, and the old Pennsylvania Hospital amphitheater. But how poorly equipped, even in my own day (1860–62) was the clinical teacher. There were no real laboratories, no examination of the blood, no knowledge of its chemistry or its physics or of its thorough examination by the microscope. Did we use percussion and auscultation? Yes, but not with the refinements of today. No critical examination of the urine beyond the chemical test for albumin was made. Palpation? Yes, and often far more thorough than today. There were shrewd clinicians who learned by touch, sight, and hearing, and not seldom also by smell, many facts of value which today are sometimes overlooked because of our too exclusive dependence on the laboratory to the detriment of our natural resources. Our senses have lost not a little skill for want of practice.

More lamentable still was the fact that the student—in those days there were no graduate students or graduate courses of instruction—only saw and heard the teacher. Never did a student touch, auscult or percuss a patient, or look through a microscope. No medical school, I think, then owned even a single microscope. Of course, it was before the day of the ophthalmoscope, the laryngoscope, and their kin. The wretched tubular vaginal speculum, which many of my readers may even never have seen, was the only "scope" we had. Soon afterward the bivalve speculum and the various "scopes" came in quick succession. Had I not been an "office student" of Brinton and DaCosta I should never have touched a patient and never looked through a microscope. Yet, in my very first lecture on surgery on the first day of the session I listened, in a dazed way, to statements about "blood corpuscles," which I had never seen, the "serum of the blood," of which I was wholly ignorant, the "crassamentum," and the "buffy coat," words which reached my ears, but not my mind.

What was still worse, all the sacred seven professors began at once to cram me in all the seven branches of medicine. What a Babel it was! Even the, to me, wholly new medical terms had little meaning until I looked them up in Dunglison's Dictionary. How much worse off were many of my fellow-students who had never studied Latin or Greek, chemistry or physics!

For clinical purposes one of the most important items is the personal history. After graduation I re-entered the army and was soon in contact again with Weir Mitchell's fertile brain. He taught me how to elicit—literally to "dig up"—the facts of the personal history as no one else ever did. A chance word which to many would have no special significance, to him was an "open sesame" to a wholly new vista of phenomena. Those who recall his familiar talks to eager graduates, who, years later, hung on his lips, at the Orthopedic Hospital and Infirmary for Nervous Diseases, will confirm what I have said.

As a rule, his diagnoses were only made after the most painstaking investigation, but from time to time he would make a sudden, flashlike diagnosis by correlating the case in hand with earlier experiences—his own or of others—with which his memory was richly stored.

The chief value of the clinical studies in the series now begun will come to the "general practitioner," the "family doctor." He is, after all, the backbone of the profession. It is for him that Frank Billings has so earnestly and rightly pleaded (Jour. Amer. Med. Assoc., February 5, 1921). Hampered too often by the necessity of constant and continuous practice for the support of his family, instead of his going to the clinic, in this and the succeeding volumes, the clinic will come to him, with but little expense in money, and almost none in time. He will learn the latest means of diagnosis, sometimes requiring instruments and skill beyond his means and his knowledge (*e. g.*, the cardiograph or technical chemical tests). But even then his horizon will be enlarged, and he will know where and from whom he can get help if need be. Moreover, these lectures will disclose means and methods which he can use or can learn. Hard experiences have often developed in the rural practitioner a resourcefulness far beyond that of his city brother in whom it remains undeveloped because it is unnecessary.

The same may be said of the newer methods of treatment. Even in the city the practitioner may often be saved from the exploiting drug or serum or vaccine manufacturer, because the clinician will tell him the truth as to the value or worthlessness of these exploited remedies and save him from therapeutic pitfalls. It is to be hoped that these clinical lectures will especially take up many of the common diseases and injuries, such as hemorrhoids, fractures of many individual bones, with the "end-results," syphilitic lesions, real and reliable serums and vaccines, with the evidence for their wonderful results, etc.

The rare and curious cases will aid, from time to time, by exciting interest, and occasionally by bringing up from the well of memory of the readers other similar but as yet unrecorded cases.

Many a good surgeon will be glad to learn from Frazier's paper the perfected and practically non-dangerous operation for tic douloureux (the spelling and pronunciation of which by doctors often leave much to be desired) and from Gibbon's clinic the Stewart incision for amputation of the breast.

In an easy colloquial manner the clinician here and there will introduce a flash of humor, or a choice bit of a quotation or an anecdote, or a literary or classical allusion by which the subject will be lifted out of the dull, prosaic routine of facts and figures and made interesting as well as instructive.

Surgical pathology bears so directly on surgical diagnosis, especially differential diagnosis, and surgical practice, that surely it will not be neglected. Such a lecture as that on "Pathology of the Living" by Moynihan (Brit. Med. Jour., 1917, II, 1381) stimulates every man who ever operates, especially in any cavity of the body; and such close, minute observations as appear in so many of Lister's clinical lectures compel one to do likewise, unless the reader lacks all ambition.

May I make here two pleas, both addressed to the clinicians themselves and in the interest of their readers.

It is only a question of time when the Metric System in thermometers, weights, and measures of length and capacity will surely be adopted. They are so far preferable, scientifically and practically, to our Fahrenheit scale, and the absurd and variable English measures, that it is most desirable to diffuse this knowledge among the rank and file of the profession. I hope, therefore, that these metric scales will always be used by the various writers, adding, if they so desire, in parentheses, the English equivalents.

Second, I hope that my age and long personal experience will warrant my pleading with every author to use the purest and best English style. Only by reading with an eye always to style[1] and by severe self-criticism can one reach this goal. My own rule in every paper I write is first to be sure that my facts are right, my reasoning logical, my conclusions valid. Then, finally, I read over most carefully and usually more than once every word *solely* with a view to its English style. And how often I catch myself lacking in clarity, using too long sentences, committing even grammatical blunders, or else a locution far inferior to one which now suggests itself to my mind. If possible, I always like to lay my paper aside for a month or more, and then revise it anew. One thus reads it almost as if it had been written by some one else. His mind is fresh, unleashed from the network of the wellworn familiar phrases, and he always finds means to improve and polish his English.

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[1] A capital instance for imitation exists in Trevelyan's "The American Revolution," so interesting and so almost invariably excellent in style. Gay's little book, "Writing Through Reading" (Atlantic Monthly Press, Boston), I have found most useful.

I fear that some such compound nouns as "heart disease," "brain tumor," and a few similar expressions are too deeply embedded in the language to uproot them, but why add to them? Why not say "renal colic" instead of "kidney colic," "gastric ulcer" instead of "stomach ulcer," "surgery of the lung" or "pulmonary surgery" instead of using such a dreadful term as "lung surgery"? An adjective before the noun is good English style, albeit of Greek or Latin derivation, but the noun + noun is not in accord with the usage of our best writers, nor with the genesis of the English language. It is proper in German, where it often leads to nouns of preposterous length. Why be ungrammatical and insist on saying "data is" instead of "data are," "data" being the plural of "datum"?

It is a pleasure to survey the constantly growing medical literature by our American colleagues. In value it is growing more and more indispensable for the practitioner who wishes to keep abreast of the times, be he American or European. Practically, I have seen all of this luxuriant growth from Gross' "System of Surgery" (1859) down to the present time.

May it always grow in value and be dedicated solely to the cause of Scientific Truth.

WILLIAM WILLIAMS KEEN.

1729 CHESTNUT ST.,
PHILADELPHIA.
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University of Pennsylvania and Lankenau Hospital

PANCREATITIS

The classical paper of Reginald Heber Fitz in 1889 gave the necessary stimulus to the study of disease of the pancreas, which, up to that time, though not unknown, had received but little consideration. Indeed, it is doubtful whether even today the importance of the pancreas in upper abdominal disturbances is generally recognized. This can be explained to some extent by the absence of a clear-cut clinical picture such as we have, for example, for peptic ulcer, appendicitis, gall-stone disease, etc.—a lack that is due to various circumstances principally developmental and anatomic. The pancreas stands in such close relationship to adjacent viscera that it is rarely diseased without involvement of neighboring organs, or rather, the pancreas generally becomes involved through some peripancreatic disturbance. In addition, the organ is not easily accessible and also has a varied and complex physiologic function. As a digestive apparatus its function may be at least partially assumed by some other organ, and its metabolic function also may be deranged without giving any symptoms of impairment of the external secretions of the pancreas.

The developmental processes of the pancreas are important in the study of pancreatic disease. Briefly stated, the pancreas arises by a succession of buddings originally springing from the primitive gut. Of this accretion of buds that finally make up the gland the terminal ones form the acini, while the rest become the ducts of the gland. The anlagen of the pancreas are a dorsal, closely related to the stomach, and a ventral, to the ductus choledochus. Some authorities describe two ventral anlagen, one of which (the left) either disappears early or remains rudimentary. The latter has been explained as being represented by the aberrant pancreatic tissue—accessory pancreas—frequently encountered by the surgeon in the wall of the stomach or the intestine, and which is capable of becoming diseased independently or which may be mistaken for a neoplasm.

The two original systems usually anastomose within the gland, the ventral, at first the smaller of the two, developing into the important duct of Wirsung, the main channel of discharge of the pancreatic secretion, while the dorsal becomes the minor excretory duct of Santorini. The glandular tissue of the ventral anlage, on the other hand, forms only a part of the head and the uncinate process of the pancreas, the greater portion of the gland being developed from the dorsal anlage. This rather complicated developmental process naturally leads to anomalies which will be considered later.

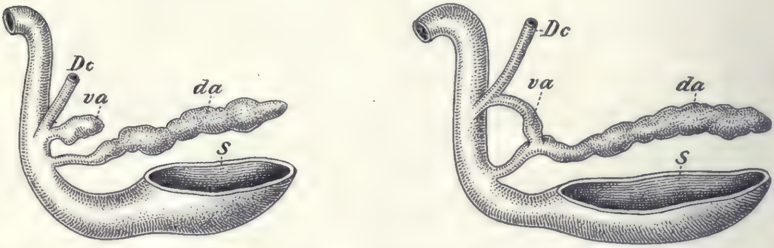


Fig. 1.—The development of the pancreas: *Dc,* Ductus choledochus; *va,* ventral anlage; *da,* dorsal anlage; *S,* stomach.

Anatomically the pancreas occupies a position in the abdominal cavity directly behind the stomach, lying transversely across the spinal column at the level of the first or the second lumbar vertebra. It is a grayish-white or pinkish, elongated gland, measuring from 15 to 20 or 30 cm. in length. In shape it is often compared to a hammer, a dog's tongue, or the letter J placed horizontally with the hook downward to the left, or to the handle of a pistol. For purposes of anatomic description it is said to consist of a head, neck, body, and tail.

The head of the pancreas is closely related to the duodenum, whose curves and variations of position it follows. Its posterior surface, therefore, may be in relation to the vena cava, the right renal vein, the right renal artery, or the right suprarenal body. The common bile-duct passes down a groove on the posterior surface beneath the upper part of the head and the duodenum; in about two-thirds of the cases the pancreatic portion of the common bile-duct is covered with pancreatic tissue. On the anterior surface of the gland the division between the head and the neck of the pancreas is marked by a groove through which passes the gastroduodenal branch of the hepatic artery. This portion is crossed by the transverse colon, above which is the pyloric end of the stomach and below which are the coils of the small intestine. The neck is grooved posteriorly by the portal vein, which is often entirely embedded in glandular tissue.

The body, the triangular prismatic portion, of the pancreas extends transversely and slightly upward from the neck on the right to the tail on the left. Its posterior surface is flattened and retroperitoneal, and is connected by areolar tissue with the posterior abdominal wall, with the anterior aspect of the aorta, the left suprarenal gland, and left kidney. The splenic vessels also run across this surface of the pancreas, the artery to the left along its superior border, and the vein behind the gland at a lower level than the artery.

The anterior surface points upward and forward and forms a large portion of the stomach bed. It is covered by peritoneum from the bursa omentalis, or lesser or gastrohepatic omentum, which separates the pancreas from the posterior surface of the stomach. On the anterior surface of the gland is also the tuber omentale, which represents the point at which the pancreas crosses the spinal column. The inferior surface of the pancreas points downward and forward. Its peritoneal layer is continuous with that of the lower layer of the transverse mesocolon. It is in contact with the duodenojejunal angle medially and with the jejunum laterally.

The tail of the pancreas is the blunt-pointed, upturned left end of the body in contact with the lower portion of the gastric aspect of the spleen, and below with the splenic flexure of the colon. Very often the splenic vessels cross from above in front of the tail of the pancreas on their way to join the spleen.

The greater part of the fully developed pancreas is retroperitoneal, its connection with the posterior abdominal wall and neighboring structures taking place by means of the vessels and the surrounding areolar tissue. While these circumstances lend a certain degree of mobility to the pancreas, it is, on the whole, less movable than other viscera, and is, therefore, less liable to take part in general visceroptosis. But I have at times been able to observe the head of the pancreas to be so movable that it could be brought well up in the wound.

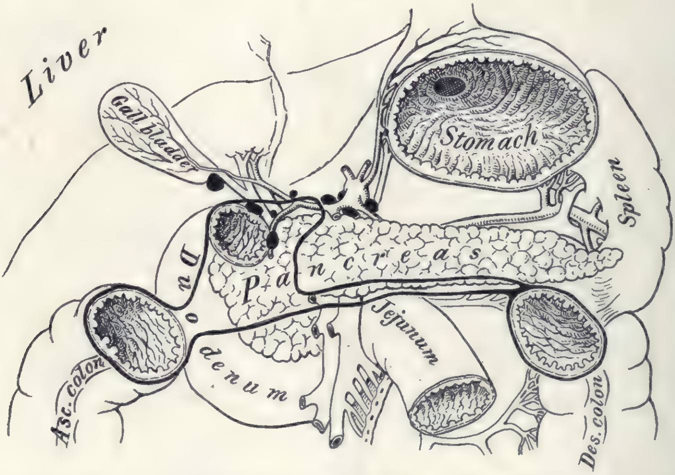


Fig. 2.—The relations of the pancreas, anterior view.

The blood-supply of the pancreas is derived from the hepatic branch of the celiac axis, the inferior pancreaticoduodenal branch of the superior mesenteric, the superior pancreaticoduodenal, a branch of the gastroduodenal artery, as well as from branches of the splenic and the hepatic arteries. The abundant arterial supply of the pancreas protects it against gangrene from occlusion; the necrosis of the organ being independent of circulatory disturbances. The veins correspond in general with the arteries. They empty into the portal vein partly directly through its small branches on the posterior surface of the gland, and partly by way of the splenic vein and the superior mesentery vein.

Within the gland the vessels anastomose in the interlobular spaces and in the lobes independently of the vessels supplying the excretory ducts. The main duct and its branches contain several small veins, while the islands of Langerhans are particularly well supplied with capillary and larger vessels.

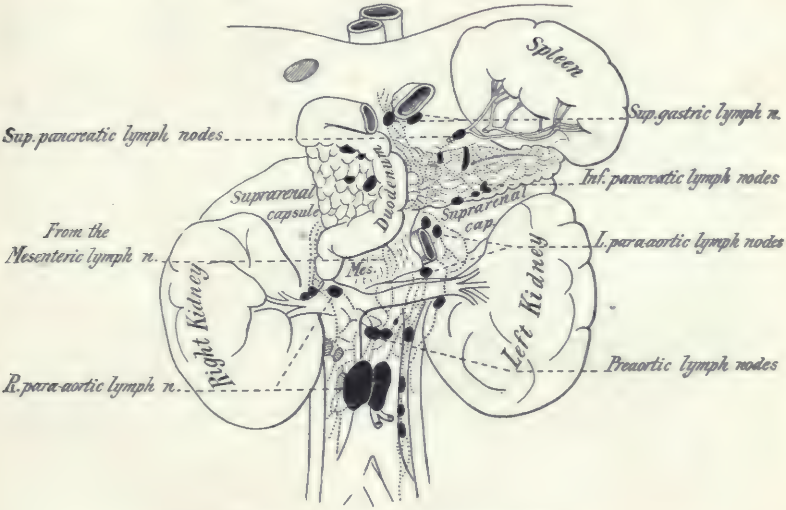


Fig. 3.—Regional lymph-nodes.

The pancreas has a peculiarly rich lymphatic system, its vessels anastomosing freely with those of the duodenum and neighboring structures. Clinically, this free communication is of importance in giving rise to the prepancreatic disease known as pancreatic lymphangitis, the term originated by Arnsperger and adopted by myself and others.

The most comprehensive study of the lymphatics of the pancreas is that of Bartels. The pancreas has no single hilum, so that the lymphatics, like the blood-vessels, emerge at various points along the surface of the pancreas and run to the regional glands, to neighboring trunks, or plexuses. The regional glands of the pancreas are the pancreaticosplenic, the superior pancreatic, the superior gastric, the hepatic, pancreaticoduodenal, anterior and posterior, the mesenteric, mesocolic, the inferior pancreatic, and the peri-aortic group of glands. To all of these the pancreas sends lymphatic branches which may anastomose in the cellular retroperitoneal tissues with the lymphatics from the stomach, duodenum, spleen, liver, gall-bladder, bile-ducts, colon, and even the left suprarenal body. The communication between the lymphatics of the duodenum and the head of the pancreas is particularly free; there is also a free anastomosis between the lymphatics of the gall-bladder and bile-duct and those of the pancreas, as demonstrated by Franke, who succeeded in injecting the lymphatics of the upper part of the pancreas from the gall-bladder.

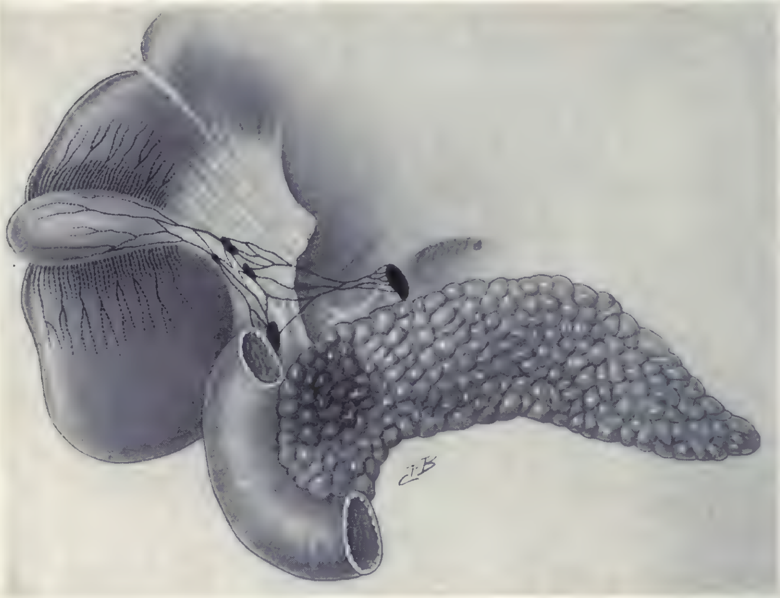


Fig. 4.—Lymphatic drainage from the gall-bladder toward the pancreas.

The pancreas derives its nerve supply from the sympathetic system, through the celiac ganglion (plexus solaris). The nerves generally accompany the arteries, although some branches enter directly into the substance of the organ. Within the gland the nerve branches, composed mostly of non-medullated fibers, follow the arterial network, forming an interlobular plexus with numerous ganglia, and finally also surrounding the glandular acini.

In its minute anatomy the pancreas is an acinotubular gland composed of branching ducts and oval or rounded acini. The acini about the terminal ducts comprise the primary lobules, large numbers of which fuse to form larger secondary lobules. The lobules are held together by a connective-tissue framework which is important owing to the changes it undergoes in chronic inflammation of the gland. A thin layer of connective tissue covers the surface of the gland (which is devoid of a capsule), while within the gland the connective tissue forms an interlobular and interacinous framework. The interacinous structure is peculiar to the pancreas. This consists of cells, known as the islands of Langerhans (named by the anatomist who first described these cells in 1869), usually located in the center of a lobule. They comprise the endocrine tissue of the gland, and are scattered throughout the greater part of the organ, although they are usually more numerous in the tail or splenic end than elsewhere in the gland. In the human system there seems to be no connection between the islands of Langerhans and the duct system of the gland. The function of these bodies is regarded as being concerned in metabolism of glucose, derangement of which is the basis of diabetes mellitus. But neither their function nor their exact anatomic structure are as yet beyond the realm of controversy.

To the surgeon the duct system of the pancreas is of particular interest. This consists, as already mentioned, of the main duct of Wirsung and the less important duct of Santorini. The duct of Wirsung begins by the union of small branches at the tail of the gland as a thin-walled whitish canal, increasing gradually in size as it passes from left to right through the body of the gland, and downward and backward through the neck into the head of the pancreas. Here it lies near the posterior surface, and is in relation to the common bile-duct, the two emptying side by side into the second portion of the duodenum below the pylorus. These two ducts then unite to form a common channel, the ampulla of Vater, which through a small orifice opens into the duodenum. This orifice is the smallest part of the biliary canal. Oddi has described a thin layer of unstriped muscle-fiber around the ampulla and the ends of the ducts, which forms a sphincter, known as the sphincter of Oddi, and which plays an important rôle in drainage of the bile-ducts.

The duct of Santorini drains a considerable part of the head of the pancreas. Near the neck of the gland it unites with the larger duct, of which it then appears to be a branch, increasing in size as it approaches the duodenum, into which it normally empties.

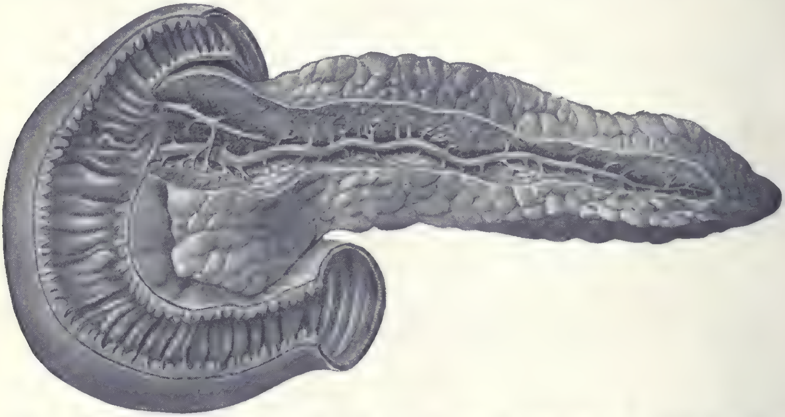


Fig. 5.—The pancreas, its ducts, and their relation to the duodenum, anterior view. (From Deaver and Ashhurst's "Surgery of the Upper Abdomen.")

The relation of the two pancreatic ducts, however, is subject to variations. They may fail to anastomose, or they may be of the same size, or the duct of Santorini may be the larger of the two. Occasionally the duct of Wirsung may not be patent, but more frequently patency of the duct of Santorini is wanting, or this duct may be so constructed that it cannot replace the function of its fellow duct in case of occlusion of the latter.

The pancreas has been well described by Sweet as a complete self-contained laboratory of physiologic chemistry. As an endocrine gland it elaborates an internal secretion essential to carbohydrate metabolism; and probably also a second secretion needed for the absorbing function of the intestine. As an exocrine gland it elaborates the very powerful ferments, to the digestive activity of which the essential feature of pancreatitis in its acute (experimental or clinical) form are now recognized as being due. From the work of Bayliss and Starling we have learned that the most powerful stimulant to pancreatic activity is not nervous, but chemical, in the shape of a hormone or messenger. This substance originates in the intestinal mucosa by the action of hydrochloric acid on a substance called prosecretin present in the cells of the mucosa of the duodenum and in the jejunum. The resulting substance—secretin—is then carried to the cells of the pancreas by the blood-stream.

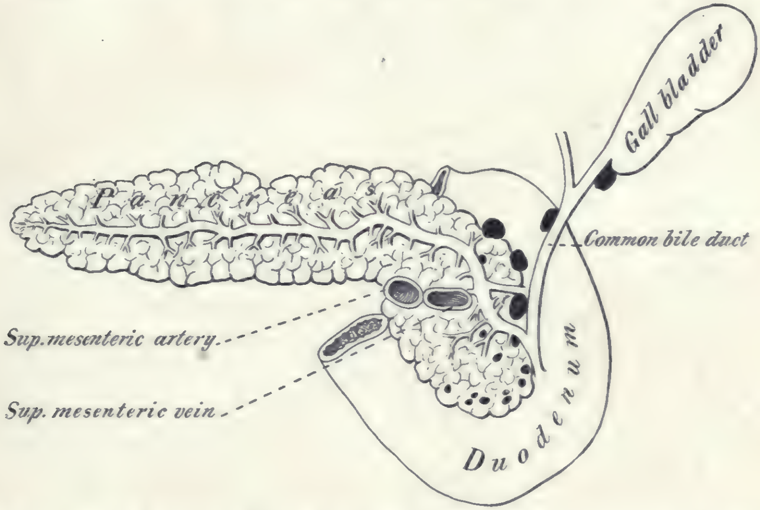


Fig. 6.—The pancreas, its ducts, and their relation to the duodenum, from behind.

The pancreatic juice, of which about 1500 c.c. are secreted daily, contains the proferments, which when activated are capable of breaking down the food proteins, fats, and starches into simpler substances capable of being absorbed directly or undergoing further digestion by the succus entericus. These ferments are known as trypsin, lipase or steapsin, diastase or amylopsin; and small amounts of maltase which converts maltose into glucose, and of nuclease, which dissolves the nucleins. It is these ferments that are the active factors in producing certain diseases of the pancreas, particularly fat and hemorrhagic necrosis.

Unfortunately, these serious phenomena associated with disturbed pancreatic function are not demonstrable except in advanced stages of pancreatic disease or at operation. But for certain kinds of functional derangement there exist some clinical manifestations of more or less diagnostic value, and also some more or less reliable functional tests. The most familiar clinical sign is that of the large bulky fatty stools, which were observed and described by Bright as early as 1833, as steatorrhea. This, however, even Bright recognized as an inconstant and not altogether reliable symptom, nor have any of the other clinical signs, such as the pupillary reaction of Loewi, and others referable to the sympathetic nervous system, proved constant. The same may be said of Cammidge's chemical urinary reaction, which in my experience at least has failed to prove its worth. With the advance in the study of disease in general a number of clinical tests have been devised in the attempt to diagnose disturbances mainly of the external secretion of the pancreas. As far as the internal secretion is concerned it is now generally conceded that it is essential to carbohydrate metabolism, and that when this is disturbed, whether experimentally by pancreatectomy, or clinically by derangement of the secretion, the result is glycosuria and diabetes.

Tests for the external secretion, that is, the presence and activity of the pancreatic ferments, may be indirect or direct. The indirect methods consist of introducing certain substances into the digestive tract which, unaffected by the gastric juice, are acted upon by the pancreatic secretion and liberate certain substances which appear either in the urine or the stools. The two most popular tests of this kind are the glutoid capsule of Sahli and the gelodurat capsule of Müller and Schlecht. The direct methods consist of examining the duodenal contents, obtained either by artificial regurgitation of duodenal secretion into the stomach by injections of a large quantity of olive oil (Volhard) or by means of Einhorn's duodenal bucket. Of the two, the latter seems to possess some degree of utility. But, on the whole, it may be said that although the approximate normal amount of the principal pancreatic ferments is known, the problem of correlating deviations from this normal with pancreatic disease is still unsolved.

The question of the pathogenesis of pancreatic disease has run the gamut of various theories, beginning with infection, retrojection of bile through impaction of a gall-stone in the ampulla of Vater, retrojection of bile into the duct of Wirsung caused by the contraction of the muscle of Oddi (Archibald), regurgitation of duodenal contents—swinging in a circle back to infection. While one or the other of these theories, all of which possess the one common feature of injury to the pancreatic tissues and activation of the pancreatic juice within the gland, may be applicable to certain cases, there is a large class of cases falling outside of such effects and in which an infective process seems to play the chief part. This has been borne out by the observation made at the operating table, that most cases of chronic and subacute pancreatitis are associated with infections of the biliary tract, and not a few with peptic ulcer or some other lesion of the gastro-intestinal tract, which produces a retroperitoneal inflammation. The problem in these cases, therefore, is reduced to the question of the route of infection. That this is by way of the lymphatics has frequently been pointed out in the joint works of Deaver and Pfeiffer. We were led to this conclusion by the observation so frequently made at the operating table that in those early cases of pancreatic diseases that are manifestly secondary to cholecystitis, it is chiefly the head of the pancreas (and often only its upper portion) that is involved. The fact that this is the portion furthest removed from the duct of Wirsung, together with the fact that the rest of the gland in these cases is apparently normal, certainly detracts from the theory of duct-borne infection. On the other hand, not only are the lymphatics known to be carriers *par excellence* of infection, but the peculiarly intimate relation existing between the lymphatics of the head of the pancreas and those of surrounding areas, so ably demonstrated by Bartels, lends strong support to our theory.

Although Bartels was acute enough to suggest the possibility of transmission of disease to the pancreas from the duodenum or adjacent viscera, it remained for Arnsperger to give the clinical evidence of this phenomenon, for which we have adopted his term "pancreatic lymphangitis" as descriptive of the origin and nature of this, the most common inflammatory condition of the gland. The sequence of events as repeatedly observed at operation and repeatedly reported by us is: cholecystitis, lymphangitis, lymphadenitis in the gastrohepatic omentum along the course of the cystic duct and the common duct, peripancreatic lymphadenitis, pancreatic lymphangitis. Therefore, as elsewhere in the body systems, treatment of the primary focus of infection is the rational step to pursue. This is all the more essential with regard to pancreatic disease, since there is every reason to assume that here more than elsewhere, owing to the powerful pancreatic ferments, the secondary effects are more serious than the primary infection.

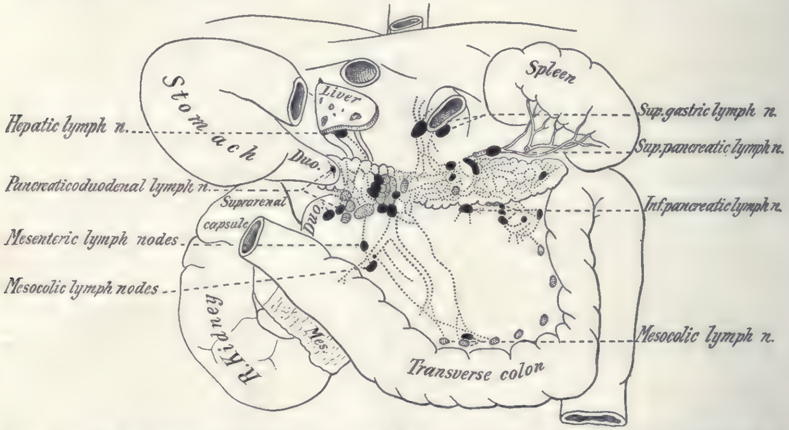


Fig. 7.—Relation between lymphatics of the pancreas and those of surrounding areas.

Once the pathologic ferment activity has begun, nothing more is needed to account for hemorrhagic and necrotic pancreatitis. Fat necrosis is the visible sign of activity of the fat-splitting ferment, but it is the proteolytic process that sets free the poisonous products, which cause the severe and often fatal toxemia, a condition which bears the expressive name of *Pancreasvergiftung*.

ACUTE PANCREATITIS

Trypsin is one of the most powerful ferments elaborated within the body. As secreted within the gland it is inactive and is known as protrypsin, which is capable of being extravasated into the tissue cells without destructive effects, but when it becomes activated (that bacteria can activate trypsin has been satisfactorily demonstrated) its digestive action is seen in destruction of tissue cells, the delicate walls of the vessels of the pancreas and surrounding structures are injured, blood escapes, and the result is an acute hemorrhagic pancreatitis.

By observation and inference the action of trypsin has also been tracked to the toxemia of intestinal obstruction. In this disorder Whipple and others have demonstrated the presence of a powerful toxin which presents all the characteristics of a primary proteose, a substance which is one of the earliest decomposition products of protein when acted upon by trypsin. The resemblance of the toxemia of acute pancreatitis and high intestinal obstruction has also been observed by Sweet. It seems not unreasonable to assume that the toxemia in both conditions is identical and is, in all likelihood, due to the toxic derivatives of the action of trypsin on protein material.

These hypotheses if they prove to be facts certainly would be of great value practically.

The casual observer is apt to limit acute disease of the pancreas to the conditions associated with fat necrosis and hemorrhage, but the fact is that acute pancreatitis may occur without these phenomena, as a simple non-suppurative inflammation characterized by swelling, edema, and possible tenderness at the site of the pancreas. While this type as seen at operation usually affects a part or the whole of the head of the organ, the inflammatory process may also be diffused throughout the gland. The fact that when thus diffused it is practically always accompanied by calculous or non-calculous cholecystitis, duodenal ulcer, or duodenitis points to the possibility of a duct-borne infection, but in the majority of the cases no doubt the infection has traveled by way of the lymphatic channels.

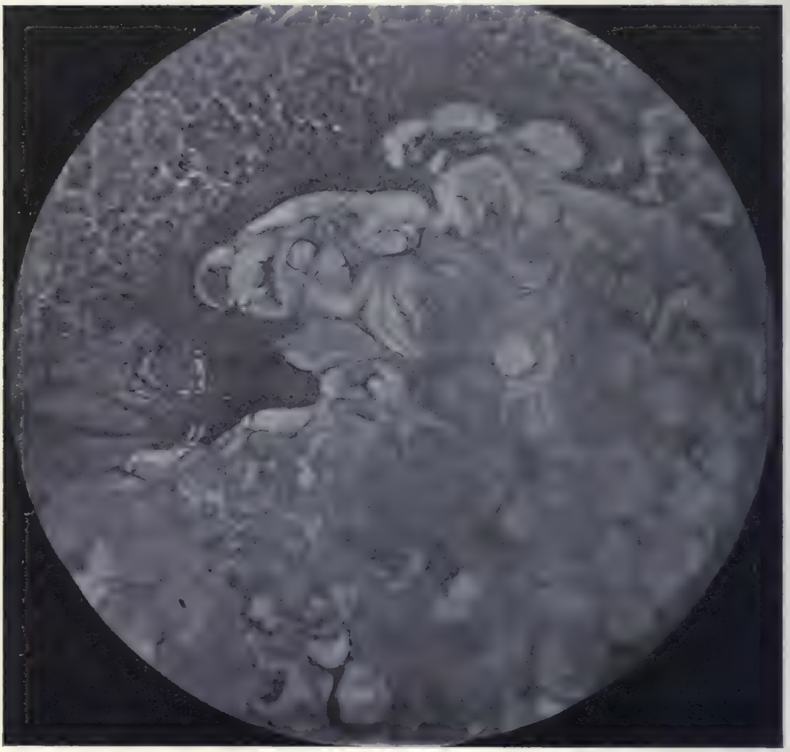


Fig. 8.—Fat necrosis.

Some years ago I was called in consultation in the case of a friend and colleague, a prominent surgeon of this city. He was suffering from an eczematous patch on the left leg above the malleolus. The condition was of long standing, the patch had become infected, resulting in a metastatic abscess on the inner anterior aspect of the thigh, and which required a wide and deep incision. This was followed later on by enlargement and breaking down of both chains of inguinal lymphatic glands on the affected side. A short time after this the patient developed upper abdominal symptoms, consisting of epigastric distress, jaundice, high temperature, weakness, loss of weight. At this time I was called in. I ventured a diagnosis of pancreatitis (subacute). When I saw the patient a few weeks later he was desperately ill and delirious, the jaundice and temperature persisting. He finally recovered from this attack and was able to resume work for a considerable period of time. He was then suddenly seized with an acute attack of upper abdominal pain, with collapse and all the signs of an intraperitoneal catastrophe, demanding immediate operation, the patient succumbing at the operating table. The surgeon in charge afterward told me that

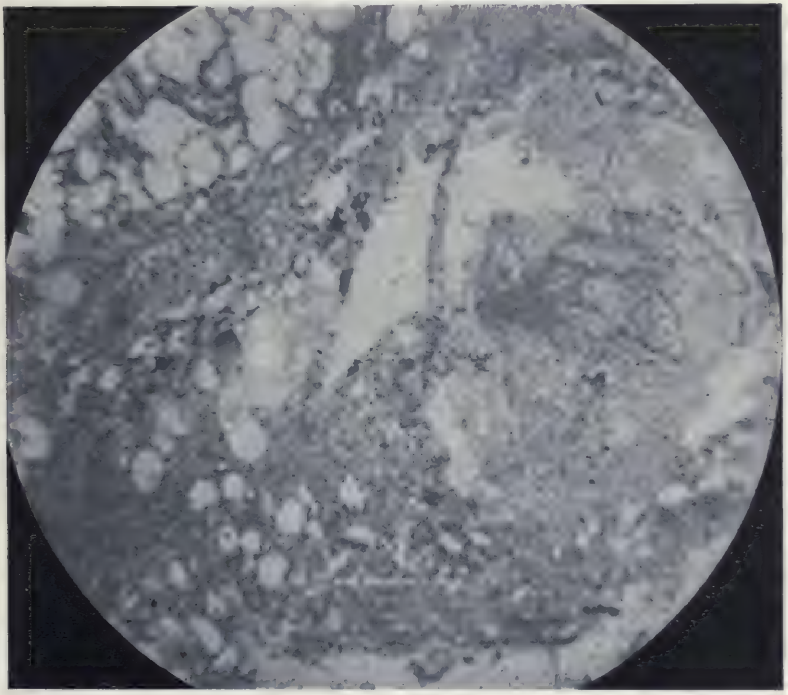


Fig. 9.—Hemorrhage and necrosis in acute pancreatitis.

the abdominal cavity was filled with pus, and that the appendix was normal.

In the absence of autopsy of course nothing definite can be said with regard to the case, but my impression was strongly in favor of attributing the condition to retroperitoneal infection, mainly by way of the peripancreatic and pancreatic lymphatics.

The possibility of a hematogenous infection has been demonstrated by reports of various observers, of pancreatitis occurring during the course of acute infections, such as scarlatina, scarlet fever, and diphtheria. In fact, it is no exaggeration to state that such simple inflammation of the pancreas probably occurs more often as a more or less deferred sequel to scarlet fever than is generally recognized.

The pancreas is often called the salivary gland of the abdomen (well expressed by the term Bauchspeicheldrüse) and, like the latter, it seems to resist abscess formation, except as secondary to gangrene of the gland, nevertheless primary suppurative pancreatitis is not unknown. We have observed at least three instances, one at operation and two postmortem. In the operative case a single abscess developed at the head of the pancreas in a child during convalescence from acute appendicitis with peritonitis; in the postmortem cases the pancreatic abscesses were multiple and scattered throughout the pancreas, associated in one instance with pancreatic calculi and in the other with gall-stones impacted in the papilla of Vater. In the case of a single abscess occurring secondary to suppurative appendicitis, infection by way of the retroperitoneal lymphatics is a plausible explanation. In the other case, duct obstruction is no doubt the responsible factor, the underlying cause, in all likelihood, being infection of the duct from the presence of the gall-stone and the stasis thus produced. Whether in such instances the infection is carried along the duct or on its surface or in the subepithelial lymphatics makes very little difference.

Much more common than the phenomena just described are those generally referred to as hemorrhagic, gangrenous, and secondary suppurative, all of them in reality being grades of acute hemorrhagic pancreatitis, which clinically can be divided into ultra-acute, acute, and subacute.

The ultra-acute, according to Mayo Robson's classification, is the one in which hemorrhage precedes inflammation and takes place within and without the gland.

The following case occurring in the Lankenau Hospital (reported by Dr. Kroger at a meeting of the Philadelphia Academy of Surgery, *Ann. Surg.*, January, 1921) is of interest particularly on account of its association with pregnancy, a combination not often observed. The woman, aged twenty-four years, was in the seventh month of a normal pregnancy. Two weeks before admission, following an automobile ride, she developed generalized abdominal discomfort and general malaise. Two days before admission she was seized with a sudden gradually increasing pain in the left upper abdomen. In twelve hours the pain had become very acute, accompanied by continuous and profuse vomiting, the vomitus at first being blood tinged (which the patient said may have come from the throat) and later dark green or brown, but without any fecal odor. No purgative was given, and enemas gave only slight results.

Past history unimportant. Menstrual history also negative. One child living and healthy.

Physical examination: Obese adult with cold clammy skin, and evidently in a state of shock. The pulse was weak, running about 160, temperature 97° F., respiration 36. Blood-pressure, systolic 96, diastolic 64. Face pale, tongue heavily coated. Head, neck, lungs negative, also the heart, except for rapid rate. Abdomen distended with a pregnant uterus. There was moderate tenderness throughout the upper abdomen, especially to the left of the midline. No rigidity and no masses palpable. Peristalsis was diminished. Uterus hard, enlarged, slightly tender and freely movable. Vaginal examination negative. Extremities cold.

The blood count showed hemoglobin 80 per cent.; red cells 5,000,000; white cells 30,000; polymorphonuclears 90 per cent. The urine contained a slight amount of acetone and diacetic acid and a few granular casts.

The symptoms were suggestive of acute perforation of the stomach or the duodenum, but the pregnancy so obscured the situation that a diagnosis was not possible.

About six hours after admission the patient developed severe pain in the lower abdomen, and suddenly aborted a dead fetus with the membranes intact. Following this she became progressively weaker, temperature and pulse rose, cyanosis set in, and death ensued twenty hours after admission.

At autopsy, upon opening the abdomen, a considerable amount of the typical beef broth fluid of pancreatitis was noted. The stomach and upper intestines were dilated. The lower ileum was markedly constricted. Areas of fat necrosis were present on the omentum. The pancreas was acutely inflamed and almost totally destroyed by necrosis. The gall-bladder, liver, and other abdominal organs were apparently normal. The microscopic sections showed acute, suppurative, hemorrhagic pancreatitis and fat necrosis of the omentum.

The term "pancreatic apoplexy" has been applied to this form of non-inflammatory hemorrhagic pancreatitis. It is marked by sudden severe onset of pain, continuous vomiting, shock, and profuse hemorrhage into the pancreas and its surroundings. Although the initial shock may sometimes abate somewhat, the disease is usually rapidly fatal, death occurring within three days. Autopsy reveals a completely infiltrated swollen pancreas, with necrosis and gangrene more or less advanced, according to the duration of the attack. These cases fortunately are rare. Surgery may be attempted and is advocated by some even in the presence of profound shock, using saline and adrenalin before, during, and, if necessary, after operation.

I doubt, however, whether operation would save a case like the following: Case No. 3160/20: Patient, male, age forty-eight years, admitted to the Lankenau Hospital in a state of collapse, and with all the signs of an acute abdominal condition. He gave a history of having developed sudden severe abdominal pain and vomiting six days before admission. Supposing this to be acute indigestion due to a "spree" the night before, he took a purge, which acted well, but the pain continued, accompanied by continuous vomiting, which was at no time fecal. He finally called in a physician, who at once sent him to the hospital.

Past medical history comprises indigestion and colicky pains for the past three years, but no attack similar to the present one. Bowels constipated. Patient partakes freely of light wines and liquors. Denies venereal infection. Physical examination: Adult male in a state of shock. Heart sounds barely audible. Abdomen slightly distended throughout and exquisitely tender to palpation. No rigidity. Peristalsis faintly audible. Temperature 101° F. Respiration 36; 200 c.c. of urine obtained by catheter. Stomach lavage yielded a dark brown, blood-stained fluid. Diagnosis: Ruptured duodenal ulcer. Patient put on regulation. Died the following morning. At autopsy the appendix, duodenum, and gall-bladder were found to be normal. The omentum was studded with small areas of fat necrosis, later verified by microscopic section. The pancreas was soft, mushy, and the seat of an acute hemorrhagic pancreatitis.

In acute, inflammatory, hemorrhagic pancreatitis hemorrhage follows upon inflammation, it is less profuse and is distributed in foci throughout the gland. The general tendency of lesions of the pancreas to produce hemorrhage has already been alluded to. Hemorrhagic pancreatitis has been artificially produced in various ways, such as artificial ischemia, the injection into the duct of various substances—oil, hydrochloric acid, intestinal secretion, activated pancreatic juice, etc.—the factor common to all these methods, as emphasized by Sweet's experimental studies, being the liberation of trypsin which causes the injury to the pancreas. Dr. Pfeiffer and myself have arrived at a similar conclusion based on anatomic and physiologic facts in conjunction with clinical observations.

Although fat necrosis and hemorrhage are not always present in acute pancreatitis, they generally play a very prominent part in the disease. The hemorrhage may be small or large, localized or diffuse, either in foci or involving the entire gland, or large hemorrhage may occur in the neighborhood of the gland, and blood collect beneath the peritoneum, infiltrating the mesenteries and omenta; in very severe cases a serosanguineous exudate is usually found in the peritoneal cavity.

Closely allied to the above is gangrenous pancreatitis. In this the hemorrhage, which is probably followed by necrosis involving blood-vessels, is often sudden and massive, involving all or part of the gland. The combination of the initial trauma and ferment activity leads to the death and sloughing of more or less extensive tissue, the prognosis depending on the extent of the process. Practically the entire pancreas is affected, presenting at once the picture of fatal *Pancreasvergiftung* in spite of all efforts to prevent its development. If the patient survives the immediate effects of the toxic process his life is still endangered by the presence of the gangrenous, sloughing, infected mass. Although this may possibly be relieved by drainage and sequestration, the chances for recovery are slim in view of the essential structures involved, and whose location makes drainage of exudates and sloughs difficult if not impossible.

A natural sequence of gangrene is the suppuration of the pancreas, that is, secondary suppurative pancreatitis as distinguished from primary abscess within the gland. In the cases that progress to this stage prognosis is somewhat brighter, since the tissues become softened and disintegrate, and with the characteristic feature of pus to find an outlet there is a chance for the evacuation of the diseased process; general peritonitis may result, but the tendency is for the pus to localize. Abscesses may form in either loin or in the lesser peritoneal cavity; sometimes in the stomach and beneath the liver by way of the gastrohepatic omentum, or in the subdiaphragmatic space. These secondary collections may spread and increase rapidly, or they may remain stationary, become encapsulated, and recede, or they may increase slowly and develop into a pseudocyst. Ulceration into adjacent viscera or into the general peritoneal cavity has been reported.

Of all acute abdominal seizures, pancreatitis probably presents the most agonizing and dramatic syndrome, and at the same time it is probably more rarely diagnosed before operation than any of the other acute abdominal conditions.

The difficulties of diagnosis are due to various causes: First, its comparative infrequency; second, the absence of a definite pathognomonic sign or symptom, its frequent association with other severe abdominal lesions, and finally, the desperate condition of the patient, which, particularly in the ultra-acute case, makes operation imperative without the formality of a diagnosis.

Diagnosis, as a rule, is possible only if the patient is seen within at least thirty-six or forty-eight hours after onset. The seizure is sudden and frequently accompanied by collapse. The initial symptoms are pain, vomiting, rapid pulse, and subnormal or normal temperature. The pain is agonizing at once and overwhelming, more so even than that of a perforating viscus. It may arise in any part of the abdomen, but usually it starts deep in the epigastrium, sometimes extending to the back and radiating to the chest and to the right or left hypochondrium.

The early subnormal or normal temperature is sufficiently constant to be of some diagnostic value in connection with the other symptoms. Later, with the effects of infection, toxemia, and weakness, there is a rise in pulse and temperature increasing considerably in the terminal stage.

The vomiting is persistent, at first containing food and later becoming bilious in character. Fecal vomiting is unusual except as a result of paralytic ileus; it is then the usual regurgitant vomiting of advanced peritonitis, and portends death. Persistent hiccup is a frequent symptom and is also a fatal sign. Cyanosis of a peculiar yellowish hue has been noted on the face, over the abdomen, and over the rest of the body.

In one case seen twenty-four hours after onset the presence of board-like rigidity led to a mistaken diagnosis of ruptured viscus. Marked rigidity may possibly be a very early symptom, but, as a rule, when the surgeon first sees the case the rigidity is not marked. Tenderness at the left costovertebral angle is an important symptom, indicating the involvement of the body and the tail of the pancreas, more especially the latter.

Distention is not so pronounced as in other acute abdominal crises, but at first is more marked in the upper part of the abdomen. Nor is rigidity marked. The bowels are generally obstinately constipated, although sometimes flatus is passed spontaneously or the bowels can be moved by enema; sometimes diarrhea is present owing to the irritation of the pelvic colon and the rectum. The leukocyte count is high, but generally not so high as in other severe or high-grade infections. Polymorphonuclears are also increased.

With regard to the rôle of age and sex in the etiology of acute pancreatitis, it is commonly stated that the patient is usually a male in the third or fourth decade of life, inclined to obesity, and giving a previous history of digestive disturbance. This, however, is subject to variations. In my experience in the Lankenau Hospital in a series of 15 cases (previously reported) the ages ranged from twenty-four to fifty-four years, and 11 of the cases were females. Linder reports 76 per cent. females in a series of 33 cases. It is worthy of note also that acute pancreatitis not infrequently occurs shortly after childbirth.

In as overwhelming and dramatic a disease as acute pancreatitis there is considerable difficulty in establishing a very definite syndrome; the signs are easily confused with acute intestinal obstruction, perforating peptic ulcer, perforation of the gall-bladder, or perforating appendix, acute cholecystitis, mesenteric thrombosis, etc. The symptoms which distinguish pancreatitis from these conditions may be briefly summarized as sudden, overwhelming pain in an apparently healthy, usually obese individual, incessant vomiting, subnormal temperature, weak pulse, upper abdominal distention, transverse resistance not easily elicited, collapse, and a peculiar cyanosis; tumor in the epigastric region, or a mass in the loin. While differential diagnosis is important, especially as it may influence the surgical incision, an error in diagnosis is not of vital moment in view of the fact that all of the above-mentioned acute conditions demand early operation, when the correct surgical diagnosis of acute pancreatitis is easily made from the characteristic exudate and fat necrosis and the palpable enlargement of the pancreas.

Recovery from acute pancreatitis without operation is not unknown. So-called pseudocysts of the pancreas are remnants of a previous pancreatitis; postmortem evidence of previous severe pancreatitis is also at hand. But it is safe to say that cases that recover by medical, that is, expectant treatment, would also recover by operative treatment; while some of those that die without operation might have been saved had they been submitted to operation.

The surgery of the pancreas must be directed to providing an outlet for the toxic pancreatic fluid which has become activated as the result of injury, either by infection, by trauma, or by a chemically induced inflammation, or due to the irritating action of the dammed-back bile. Instant drainage of the pancreas is the procedure indicated.

Resection of the pancreas is not as yet a practical measure. Any further surgery depends upon circumstances.

The condition of the patient permitting, attention to the bile passages and the gall-bladder is not out of place. But it may be said in passing that in all likelihood attention to previous symptoms referable to these organs might have prevented the subsequent catastrophe. In a series of 18 cases of acute pancreatitis, gall-stones were present in 15. From this and other similar observations the conclusion is almost inevitable that gall-stones are responsible for a large percentage of cases. Dealing with the gall-bladder and bile passages should form part of the operation whenever possible. In this same series the gall-bladder was drained in 11 cases—with 3 deaths—in 2 the gall-bladder and the common bile-duct were drained, both patients recovering, and in 4 the operation was limited to the pancreas, the bile passages being untouched—3 of them recovered and 1 died. One patient died on the operating table before any surgery could be undertaken. Other associated conditions, if present, such as duodenal ulcer or duodenitis, cannot receive attention at this time. The essential thing is draining the toxins away from the pancreas. Pancreatostomy is beneficial if for no other reason than the relief of tension it affords.

The approach to the organ can be either a transperitoneal one or extraperitoneal through a loin incision. In case of abscess the latter allows approach to the pancreas, especially its tail, without entering the peritoneal cavity, but at the same time it has the disadvantage of not permitting free exposure. It is feasible only in cases where the symptoms point to localization of the inflammatory exudate or the presence of pus in the loin, which is walled off by the abscess.

The transperitoneal route is the choice in beginning pancreatitis or when the diagnosis is doubtful. The doubt is generally soon dispelled by the presence of fat necrosis and the typical odorless beef-broth fluid in the peritoneal cavity. The pancreas itself is reached through the gastrocolic omentum, through the lesser omentum, or through the transverse mesocolon. This permits of free exposure and adequate drainage—the latter a most important consideration. The advantages of the mesocolic route, however, are offset by the greater risk of contamination on account of the presence of the numerous coils of small bowel. In acute hemorrhagic pancreatitis the indicated procedure is to expose freely and drain freely. The question of the extent of incision or scarification of the organ itself is a delicate one. Too large an incision presents the risk of hemorrhage difficult to control. But scarification of the peritoneum over the gland should be sufficient to permit gauze drainage to be brought into direct contact with the surface; this also opens up the retroperitoneal space and thus may help to prevent accumulation about the pancreas. A few blunt punctures of the pancreas may be of service in opening up the ducts and providing an outlet for the secretion. The most important item is arranging the gauze drainage as indicated above. One or more tubes should be included in the drainage. Both the tube and the gauze drainage should be conducted to the surface through an enveloping sheet of rubber-dam, to reduce the chance of adhesions to the stomach and intestines, and render the subsequent removal of the gauze less painful. Free fluid in the peritoneal cavity must be removed as far as possible by gentle wiping, and also by means of a glass tube inserted in the pelvis through a stab wound above the pubis, since the pancreatic exudate itself contains sufficient toxic material to cause death. It is interesting in this connection to note that one of the first cases of recovery from acute pancreatitis was reported by Halsted, who did nothing more than sponge out the serosanguineous exudate. Other similar instances have since been reported, but they are probably all of them mild cases unaccompanied by the extensive necrosis which constitutes the fatal toxemia of severe pancreatitis.

The gauze drainage should be allowed to remain until it comes away almost of itself, of course, with proper precautions to prevent the damming back of exudate. Too early removal of the gauze may cause bleeding, thrombosis, and spreading infection. On one occasion when I had the gauze removed too early there resulted such profuse hemorrhage as to threaten the life of the patient. The wound was then repacked and the gauze allowed to remain for two weeks.

The most serious danger during convalescence is secondary hemorrhage owing to the close relation of the pancreas to numerous large vessels and the erosive action of the exudate. This is a valid reason for limiting the incisions in and about the pancreas, and not overpacking with gauze. It is well known that necrosis of vessels is more likely to occur when in contact with drainage.

One of the most troublesome postoperative effects of drainage in acute pancreatitis is the formation of sinuses. The effect of the powerful pancreatic ferment on the tissues can be seen in the intensely irritated skin over which the discharge flows and in the sluggish manner of granulation subjected to the severe erosive action of the pancreatic fluid. For this reason the skin should be protected by a bland ointment to prevent contact with the secretions, for once excoriations take place it is almost impossible to get anything to stick to the moist surface. A strict antidiabetic diet is advisable and has been found useful in promoting healing.

CHRONIC PANCREATITIS

What has been said with regard to the difficulties of recognizing acute pancreatitis—absence of a definite syndrome and of entirely reliable clinical tests—applies as well to the disease in its chronic state. What has been gained from discussion and observation of pancreatitis has been the established fact that the pancreas is subject to chronic disease and that it plays an important rôle in the syndrome of certain digestive disturbances which have hitherto been referred entirely to adjacent viscera.

Chronic pancreatitis, therefore, cannot be considered a rarity, and the pancreas must enter into consideration in upper abdominal disease.

Chronic pancreatitis is generally considered as existing in two chief forms, one of which involves the interlobular septa and the parenchyma of external secretion, and the other attacks mainly the islands of Langerhans, and to a degree the secretory tubules and interlobular structures. The latter is the type associated with carbohydrate metabolism which in pronounced cases develops into diabetes. Interlobular pancreatitis, on the other hand, is characterized by digestive disturbances.

Owing to the inaccessibility of the pancreas and the difficulty of observing the gradations from early lesions to late effects, and also because of the scarcity of early material and the difficulty of studying the finer parenchymatous changes, due to the rapid self-digestion of the organ after death, the chain in the pathologic process is still incomplete.

In the course of this discussion the rôle of disease of the lymphatics about the pancreas as the first stage of pancreatitis has been several times referred to. Reasoning along these lines, chronic pancreatitis may be classified as follows—chronic lymphangitic pancreatitis; chronic interlobular pancreatitis; chronic interacinar pancreatitis, the last two (and cirrhosis of the pancreas, described by Robson) being the end-results of a pancreatitis.

Briefly stated, the pathology of chronic interlobular pancreatitis consists of an increase in interlobular fibrous tissue, with or without inflammation; while in the interacinar type the increase of fibrous tissue insinuates itself between the acini, which become more or less distorted and degenerated. Intermediate states between the two also exist, in which the fibrous tissue attacks the interlobular septa as well as the lobules, and leads to chronic induration or cirrhosis of the pancreas.

But the primary factor in the production of these changes is, we believe, an early inflammatory change without fibrosis, in the form of a lymphangitis transmitted to the pancreas through infected neighboring structures. Accordingly, infection carried by way of the lymphatics plays the most prominent rôle in the etiology of pancreatitis, although at the same time the possibility of other portals of entry is admitted: the blood-stream, the duct or ducts, and by direct contiguity.

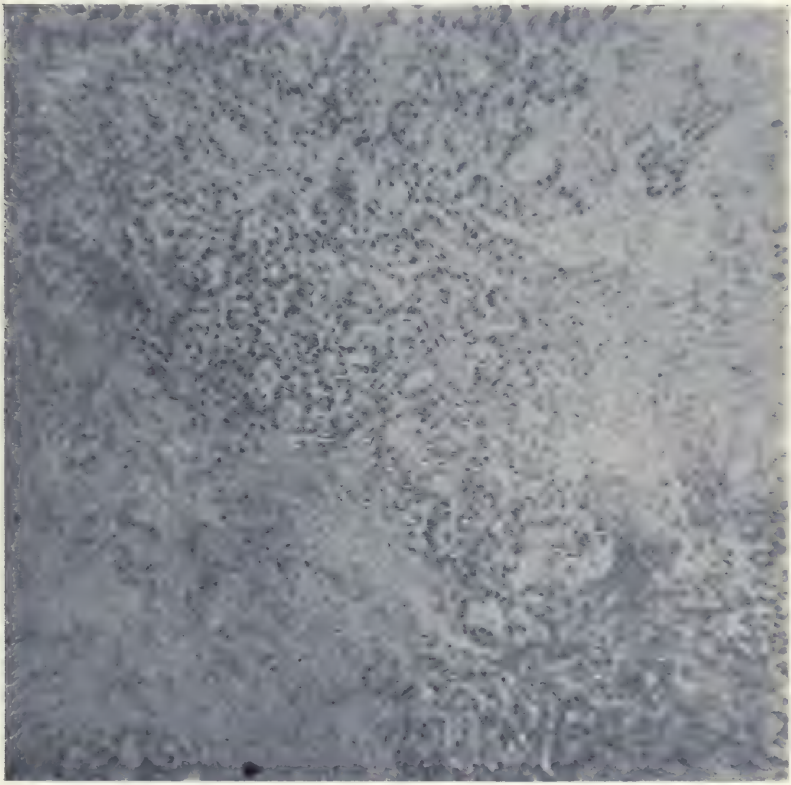


Fig. 10.—Inter- and intra-acinar chronic interstitial pancreatitis.

Although there is no reason why the infection cannot be carried to the pancreas by way of the blood-stream, the gland, at least as far as clinical evidence is concerned, seems, as a rule, to be immune to the ordinary bacteremias.

On the other hand, duct-borne infection, through the duodenum or the common bile-duct, has generally been considered to be the route by which the pancreas most often becomes involved. While the close relationship of the pancreatic ducts to the duodenum and the common bile-duct, and the frequent association of biliary disease and chronic pancreatitis seem to support this view, it does not accord with surgical experience.

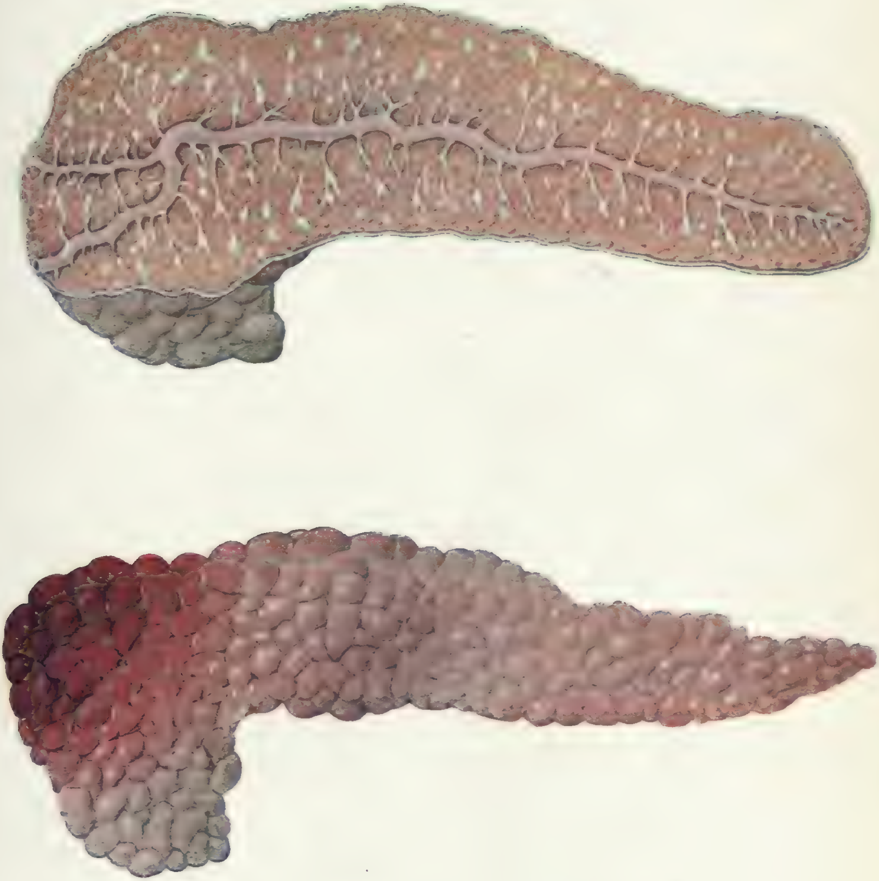
If the infection were carried by way of the duct system we would naturally expect a diffuse pancreatitis—affecting the entire gland—but at operation we find that in most instances chronic pancreatitis is most frequently associated with inflammation of some other abdominal viscus, and that the diseased part of the gland—the head—is that which has a free lymphatic relationship with the affected viscus. The part of the head of the pancreas that is most often found diseased is known as the triangle of infection (Plate I), that is, the area between the ducts of Wirsung and of Santorini. Inference, therefore, would lead to the conclusion that chronic pancreatitis, as it appears to the surgeon, is a retroperitoneal infection secondary to the more common forms of abdominal inflammation, of the duodenum, the gall-bladder, the pylorus, the appendix, and other parts of the intestinal tract, all of which are connected by a retroperitoneal chain of lymphatics.

Obstruction plays a very minor rôle in the more common type of chronic pancreatitis as seen at operation. At the same time some cases of chronic interlobular pancreatitis are due to obstruction, as from pancreatic calculi, biliary calculi in the duodenal portion of the common duct, neoplasms, inflammatory tumors, and cicatricial processes involving the duct.

As to the influence of sex and age in the incidence of chronic pancreatitis, we find it more prevalent among males (58 per cent. of our cases), and in the third to the fifth decades of life. A number of cases have been reported below and above these extremes.

From what has already been said, the rôle of disease of other upper abdominal viscera in the etiology of pancreatitis is evident. Tuberculosis and alcoholism also sometimes must be taken into consideration, while direct trauma as an etiologic factor is aptly illustrated in the following case:

PLATE I



Hardening of the head of the pancreas.

No. 2964/20. Female, age thirty-five years. Admitted 9/28/20. Discharged 12/23/20.

History.—Two years of periodic attacks of pain in upper right abdomen about two hours after eating. Occasional vomiting of bile. No jaundice or clay-colored stools. Loss of weight—6 pounds in past six months; symptoms also increasing in that time. Nervous.

Appendectomy two years ago (elsewhere).

Blood-pressure, 116/79.

Physical examination: Slightly anemic adult. Head and neck negative. Heart, impaired muscle tone. Lungs negative. Abdomen, moderate tenderness over gall-bladder. No definite masses felt. Extremities negative.

W. B. C. = 12,500
Polymorphonuclears = 58

	Test-meal.	Full meal.
Quantity.......	50	30
Free HCl......	5	39
Total acidity.........	19	97

9/30/20. Operation: An ulcer was found on the second portion of the duodenum. Adhesions between the pancreas and the duodenum were separated, the duodenum invaginated, the head of the pancreas sewn over the duodenal stump. A pylorectomy was done, including the ulcer, and the operation completed by a posterior gastro-enterostomy. The gall-bladder in this case was normal.

Postoperative the patient ran an irregular temperature, became restless and nervous, and somewhat distended. Stools, per enema, were dark, bulky, and odorous. On the sixth day patient complained of severe pain in the left side and difficulty in breathing.

10/15/20. Fluoroscopic examination: The left diaphragm is fully 1 inch higher than the right, and is completely immobilized, suggesting a secondary collection, but no actual collection can be seen on account of the patient's size.

10/16/20. Operation: Median incision revealed hemorrhagic pancreatitis with fat necrosis studding the pancreas and the omentum, also plastic exudate and pus under the left lobe of the liver. Drainage: Three small cigarette drains, two small rubber tubes, one rubber-dam, one piece of gauze.

The postoperative course after the second operation was not satisfactory. Both pulse and temperature remained high, the patient complained of pain in the upper left abdomen, was generally weak, and showed little desire for nourishment. On the second day she developed severe pain in the left loin space and marked tenderness at the left costovertebral angle.

11/20/20. Third operation: With the patient on the right side an incision was made into the left loin space. Foul creamy pus, also particles of pancreatic tissue exuded from the wound. The cavity was washed out with permanganate solution, and rubber tubes sewed in. There was no connection between the cavity and the original opening.

Recovery after this was uneventful. The patient was discharged two weeks later with a small drainage-tube still in the wound.

Primary uncomplicated chronic pancreatitis is not a very common occurrence, nor are its symptoms very well defined or exclusive of other conditions. In the following illustrative case the symptoms might suggest duodenal ulcer, except that their duration and the number of attacks are less than are usual for ulcers.

No. 3007/20. Male, aged thirty-nine years. History of an attack one year ago of pain coming on about four hours after eating, lasting about two days. Similar attack about four weeks ago, accompanied by nausea and vomiting. Food and soda gave some relief. In neither of the attacks was there belching of gas or jaundice. Loss of weight 7 pounds in past three years.

Physical examination: Well-developed, poorly nourished male. Details negative, except for tenderness on deep palpation over umbilical region and localized points of tenderness to right, at fourth lumbar vertebra.

Urine and stool negative. No masses or organs palpable. Nothing obtained from test-meal.

x-Ray: Duodenal deformity and imperfect filling suggestive of duodenal ulcer except that peristalsis is subnormal.

10/4/20. Operation: Duodenum and pylorus normal. Enlarged glands around pancreas. Pancreas hard, nodular, indicating chronic pancreatitis. Adhesions to gall-bladder released. Common duct clear. Anastomosis made between gall-bladder and duodenum. Chronically diseased appendix removed by clamp and cautery. Stump inverted.

Drainage: One piece of rubber-dam beneath enterostomy.

Patient made an uneventful recovery and was discharged in good condition.

This patient reported in person to the Follow-up Clinic three months after discharge. He appeared perfectly well, claimed never to have felt better in his life, and had gained 11 pounds in weight.

The symptoms of the chronic disease are usually those of the associated lesion, especially of the biliary tract. In an analysis of 30 cases of pancreatitis operated on at the Lankenau Hospital, of Philadelphia, not associated with gall-stones, but one-third of which gave evidence of gall-bladder inflammation, the symptoms, in the order of frequency, were recurrent attacks of acute severe pain in the epigastrium, and the right costal margin (with scattering instances of pain in the left costal margin, in the lumbar region, and general abdominal pain). The pain sometimes is referred to the right shoulder, the back, and occasionally the left shoulder. Referred pain, however, is considerably less frequent than in cases complicated by biliary calculus. Next in frequency were jaundice, flatulency, vomiting, history of indigestion, colicky pain, and indigestion between attacks.

Gastric analysis showed subnormal acidity in about 84 per cent. of the cases in which the analysis was made. Jaundice when present is associated with the usual signs of obstruction to the flow of bile, clay-colored stools, and bile in the blood-serum and urine. Glycosuria is noted in about 7 per cent. of our cases. According to Cammidge bile obstruction is not complete, a certain amount of bile reaches the intestine and can be recognized in the feces as stercobilin. As a rule, it may be said that jaundice *per se* is not an important feature of pancreatitis, its presence being nearly always due to an associated lesion of the bile passages. Nevertheless the observation has been made that obstruction of the common bile-duct by direct pressure, enlargement of part of the gland that surrounds the duct, does take place. Also some cases of chronic jaundice with an enlarged and sclerotic pancreas have cleared up by draining the gall-bladder, either by cholecystotomy or by a cholecystoduodenostomy, or anastomosis with the stomach or other section of intestine. Physical examination reveals tenderness in the right costal margin, and in a few instances in the epigastrium and in the left costal margin. Désjardins has described a *pointe pancréatique* presumably corresponding to the outlet of the duct of Wirsung, located from 5 to 7 cm. from the umbilicus in a line running to the apex of the right axilla which, however, is not of much diagnostic value.

Owing to its deep-seated location the pancreas is rarely palpable except in individuals with lax and thin abdominal walls, or perhaps under anesthesia.

As already stated, pancreatic function may be disturbed without giving early signs of its derangement. The various tests for abnormal function and their value as suggestive or confirmatory evidence have already been referred to. The diagnosis of chronic pancreatitis, however, mainly rests on the history of the patient together with the physical and clinical signs; but in the majority of cases exploration alone will decide.

The differential diagnosis from other diseases of the upper abdomen must generally be made on the essential features of these possibilities, since, as we have frequently stated, the pancreatic syndrome is not a definite one. At operation it is most important to distinguish between an advanced indurative pancreatitis and a malignancy of the head of the pancreas or of other adjacent viscera that may cause jaundice.

At the same time the differentiation between chronic inflammation and cancer of the head of the pancreas is a matter of great difficulty, nay, I might say it can rarely if ever be made. Even the most experienced surgeon has diagnosed cases as chronic pancreatitis which I have later proved to be carcinoma, and vice versa.

Unfortunately, removal of a specimen of pancreatic tissue for the purpose of diagnosis by frozen section is fraught with too much risk of unpleasant consequences to make this convenient and reliable method of use in these cases.

In doubtful cases the patient should, therefore, be given the benefit of the doubt by draining the bile externally or into the duodenum, stomach, or intestine.

From what we know of chronic pancreatic disease the inference is natural that its treatment is closely bound up with the treatment of the diseases with which it is usually associated, which, in turn, are practically always surgical diseases.

In a measure, therefore, preventive treatment is of importance. The liability of involvement of the pancreas in other diseases of the abdomen, particularly of the gall-bladder and bile passages, which do not yield promptly to medical treatment, is a strong argument in favor of early operation for these disorders. Likewise in the treatment of chronic pancreatitis itself, once it is established, delayed operation is full of danger in view of the irremediable changes that may take place.

For the present we have no promising means of direct attack upon the organ, so that the surgical treatment of chronic pancreatitis becomes a question of the best treatment of the pathology of the biliary tract encountered at operation.

Every infection of the gall-bladder is an interstitial one, and as such is chronic and persistent. The experience of return of symptoms after gall-bladder operation shows that such recurrences are more apt to take place after the conservative operation than after removal of the gall-bladder. It is for this reason that if the gall-bladder is diseased, I prefer to do a cholecystectomy, and also if the disease of the pancreas is not so pronounced as to cause common duct obstruction. For the gall-bladder is so often the primary focus of infection and within its walls harbors pernicious bacteria, particularly streptococci, which cannot be eradicated by simple drainage. Where there is evidence of calculous obstruction of the common duct choledochostomy is indicated together with removal of the calculi and the passing of a large probe into the duodenum to make sure that the opening is patulous, and to secure full dilatation.

If, however, jaundice is present and cannot be attributed to stone obstruction, but is due to pancreatic pressure, it is best to provide for prolonged internal drainage by means of a cholecystoduodenostomy; or, as has been done by Kehr, making an anastomosis with the stomach; or with the jejunum brought up through the gastrocolic omentum, as recommended by Ochsner; or into the intestine lower down, according to circumstances and the judgment of the individual operator. Prolonged drainage can be provided by stitching the gall-bladder to the abdominal wall; or the organ can be removed and drainage obtained by means of a T-tube in the common duct, which can be kept in position for as long as may be desirable.

I have had a case in which after three operations upon the common duct for cicatricial stenosis and chronic pancreatitis a T-tube has been worn for two years with little if any discomfort and very little discharge. The patient refuses to have it removed for fear of a recurrence. Indeed, one of my patients has worn a T-tube for as long as four years.

Prolonged drainage for the cure of pancreatitis acts in two ways: By removing infection, it gives the pancreas a chance to throw off inflammation; and secondly, the relief of intraductal pressure (in cases where the pancreatic duct and the common bile-duct anastomose before discharging into the papilla of Vater) gives the pancreas the chance to recover itself. The ability of the pancreas to recover itself has been demonstrated by various authors—notably Körte. In 1895 he operated on a case in which fat necrosis and a serosanguineous exudate were present. Not being as yet familiar with this chief characteristic of pancreatitis, he closed the abdomen without attacking the pancreas. The following year he was called upon to operate on the same case for calculous obstruction of the common duct. The pancreas was examined and found to be entirely normal.

Archibald also advocates prolonged drainage either by a cholecystostomy or a choledochostomy, preferably the latter, for the cure of pancreatitis, but he offers a somewhat different explanation of its beneficial effects. According to his hypothesis, most cases of pancreatitis when unassociated with gall-stones or cholecystic disease are due to the presence of bile in the pancreas. Normally the introduction of bile into the organ is prevented by the action of the sphincter of Oddi at the outlet of the common bile-duct. It is by spasm of this sphincter and the consequent rise of bile pressure in the bile tract that bile finds its way into the pancreas with a more or less severe pancreatitis as the result.

For this reason Archibald proposes cutting the muscle of Oddi in order to ōvercome the spasm and the pressure, and to provide prolonged drainage.

Occasionally a choledochoduodenostomy or reconstruction of the common duct may be required, but in most conditions which show no disease of the gall-bladder or of the bile-ducts, and in which there is no evidence of other primary foci of infection, the biliary tract is the best avenue of approach to the pancreas, and drainage by means of a cholecystostomy is the most promising medium of removing infection of the biliary tract (that may be present and not recognized) or otherwise favorably influence the pathologic process in the pancreas itself.

Peptic ulcers if present should, of course, be treated at the same time, preferably by excision; or, where this is not feasible, by exclusion of the pylorus and a posterior gastro-enterostomy. The appendix also should be examined and the pelvic organs (in women) for the presence of inflammatory tissue, which should be removed.

The possibility of direct surgery of the pancreas has been demonstrated experimentally by Sweet and others, but as yet it is of academic interest rather than of clinical value.

The practical value of a limited study of this kind is, I hope, to emphasize the importance of the pancreas as a digestive organ, and the necessity of considering it in the diagnosis and treatment of upper abdominal disease; also the etiologic relationship of disease of adjacent viscera and pancreatitis and the possibility of preventive treatment of pancreatitis by early attention to these conditions.

CLINIC OF DR. J. CHALMERS DACOSTA

Jefferson Hospital

HYDATID CYST OF THE LIVER

The patient I now present to you is a man twenty-eight years of age, a Greek by birth, who has been in this country for ten years. He has always worked about a restaurant, and of recent years has managed such an establishment. He has been a very healthy man for many years and has received no injury of which he has any recollection. About one year ago, that is, nine years after his departure from Greece, he discovered a small lump in the right hypochondriac region. It was neither painful nor tender. It has increased gradually in size until it has attained the considerable dimensions that you now observe. During all this time there has been no pain, no tenderness, no indigestion, no diarrhea, no jaundice, in fact, there have been no symptoms at all. An interesting fact in this man's history is that he never eats meat. He lives entirely on vegetables, on pies, and on fruit. He eats salad, water-cress, celery, etc., and eats these things uncooked.

The lump in the right hypochondriac region projects distinctly forward and it is visible as well as palpable. It is hemispheric in outline, smooth to the touch, can be pushed back from the abdominal wall, and, therefore, is not adherent to the parietes. It is dull on percussion, and the dulness is continuous with the dulness of the liver. Percussion does not give that purring vibration known as hydatid fremitus. There is an obscure but distinct sense of fluctuation. On deep inspiration the mass descends with the liver. The tympanitic note of the colon can be made out below the mass. There is no intestine in front of the mass.

This patient was referred to us by my colleague, the Professor of Genito-urinary Surgery. The man was brought to his department under the belief that the condition involved the kidney. Obviously, the mass is not an enlargement of the kidney. It cannot be felt at all in the loin. There is no dulness on percussing the lumbar region. There is no intestine in front of the mass, as there should be in a kidney enlargement. The hand in the loin cannot lift the abdominal mass. Pressure on the mass does not make it palpable in the loin. There is no ballottement as is common in kidney cases. We try to develop ballottement by giving a sudden push in the loin which causes a kidney tumor to move away from the fingers, and while the fingers are held in place the tumor drops back upon them again. I might add that there have been no symptoms of any sort pointing to the kidney and that the urine is perfectly normal. So we are satisfied that we are not dealing with a condition of renal enlargement.

In spite of its prominence to the eye, the mass is not a growth of the abdominal parietes. The superficial parts of the abdominal wall are obviously perfectly normal and the mass does not move with the abdominal wall during respiration, but descends and ascends with the liver.

We can exclude distended gall-bladder as the trouble. There is no pain, and he has not had any pain. There is no tenderness or rigidity. There are no constitutional symptoms. An enlarged gall-bladder is usually a movable mass. The growth with which we are dealing cannot be moved from side to side and moves only with the liver. An enlarged gall-bladder, if not fixed by adhesions, can be moved from side to side like a pendulum and can be pushed backward in many cases.

So we reach the conclusion that we are dealing with a cyst or new growth of some sort, connected with the under surface and anterior margin of the liver. It is not a cancerous growth. It was detected more than a year ago. There is no cachexia. There has been no loss of flesh. There is no nodulation such as is the rule in cancer of the liver. The growth is smooth and hemispheric. Most cancers of the liver have numbers of nodules which can be felt through the wall of the belly and the entire liver is usually enlarged. The blood examination in this man shows that there is no distinct anemia and no loss of hemoglobin as there would be in cancer.

Are we by any possibility dealing with a gumma of the liver? This man denies syphilis and has a negative Wassermann reaction. In most cases tertiary syphilis of the liver causes irregular areas of inflammation in Glisson's capsule and also hepatic cirrhosis, but a large and solitary gumma can form and also small gummata. The situation of this growth is the common situation for a solitary gumma, that is, the anterior part of the right lobe. A person with a solitary gumma after a time develops pain, often fever, and perhaps jaundice. It is one of the causes of the mysterious fevers we encounter now and then in practice. This growth is altogether too large for a gumma. A gumma would have broken down long before it could have attained such a size.

There seems to be no other probable condition ordinarily encountered which we think of. It certainly is not a tumor of the mesentery; a tumor of the omentum; or a tumor of the colon. The query is, What can it be? It might be a solitary cystic adenoma arising from the bile-ducts. Years ago I helped Professor Keen operate on such a case. Solitary adenoma is an extremely rare growth. We offer a diagnosis of this case with considerable hesitation because of the great rarity in this country of the disease we suppose to exist. I believe this is a hydatid cyst of the liver. It is one of those remarkable cystic formations that is due to the implantation in the liver of the tapeworm of the dog in a larval stage. We must not reject a diagnosis purely and solely because a condition is rare. In the first place, the disease does occur in this country and probably more frequently than has been suspected. In the next place, the liver is the organ most liable to attack. In the third place, the cyst that is formed in hydatid disease corresponds in character to the cyst which exists in this man. A hydatid cyst of the liver grows with moderate rapidity, is dull on percussion, fluctuates if near enough to the surface and if the walls are not too tense.

If the walls are tense or far away there is elasticity rather than fluctuation. There may or may not be hydatid fremitus. The sign is a rare one. By this term we mean a curious vibration which is sometimes obtained when a part of a cyst is palpated or squeezed with one hand, while another portion of the cyst is percussed with the fingers of the other hand. This hydatid purring can be imitated by laying three fingers lightly on a spiral sofa spring and tapping the spring with the middle finger.

In a great many cases of undoubted hydatid disease, hydatid fremitus, thrill, or purring is absent. When present it is supposed by many to be due to large daughter cysts knocking against the wall of the mother cyst. Its absence in nowise counts against the diagnosis. Santoni's sign is absent. This sign is a short, booming sound obtained by placing the stethoscope over a portion of the cyst and percussing another portion. A very significant fact in favor of the diagnosis is, in the words of Rolleston, that "there are physical signs, but no symptoms." Hydatid diseases of the liver may cause symptoms when it presses upon the bile-ducts (jaundice), upon the portal vein (ascites), when it suppurates or when it ruptures. Here is a sac, certainly large enough to contain a quart or more of fluid, and yet the man feels perfectly well, looks perfectly well, hasn't a trace of pain, a hint of indigestion, or the faintest hue of jaundice. There is no suggestion of any trouble but the presence of the lump. The blood examination of the patient shows 3 per cent. of eosinophils, not enough of these cells to point absolutely to parasitic disease. The spleen is not enlarged; it often is in hydatid disease of the liver. There is no history of an attack of urticaria. Such an attack may occur during the existence of hydatid disease. I shall make no attempt to confirm or set aside the diagnosis by the dangerous procedure of tapping or aspiration.

In reading the history I called attention to the fact that this man is a vegetarian and lived on lettuce, celery, uncooked fruits and vegetables, and didn't eat any meat at all. Professor Dieulafoy has pointed out that vegetarians suffer from hydatid disease more commonly than do those more sensible persons who eat the things nature intended for them. A vegetarian, when he is shown the teeth meant for tearing meat, assumes the position of Alphonso the Wise, of Castile, that is, "the world is a crank machine and the Almighty should have taken advice."

You may well ask me, Did this man bring the disease with him from Greece? It is not uncommon in certain parts of Europe. It is very uncommon in the United States. It is not possible that he could have brought it with him. He arrived here ten years ago. When we think of the usual moderately rapid growth of a hydatid cyst of the liver (it attains the size of a walnut in a few weeks), it is impossible to conceive that ten years could have been occupied by this mass in attaining its present size. The man acquired the disease in this country. He has acquired it either from infected water, or from unwashed and uncooked fruits or vegetables, or other things contaminated by the eggs of the tapeworm of the dog. We will discuss in some detail the subject of hydatid cyst of the liver and will then proceed to perform the operation required by this case.

The tapeworm of the dog, of the wolf, and of the jackal is the Tænia echinococcus. It has a head and neck and three or four segments or proglottides, of which the final one is the largest and is in a condition of maturity. The head has from thirty to forty hooks and four suckers, and the last segment contains about five hundred mature eggs. It is the smallest tapeworm found in any domestic animal. Enormous numbers of them may live in the small intestine of the dog. If a man, a pig, a sheep, or a ruminating animal swallows food or drinks fluid containing these eggs, the eggs are liberated in the stomach from the gravid tapeworm segment. The embryo or oncosphere which escapes from the egg has six hooks. The embryos pass into the intestine, penetrate the intestinal wall by boring, and reach the liver, in all probability by way of the portal vein. On reaching the liver the parasite develops into the larval or bladder stage. A cyst begins to form, grows progressively, and may attain a very large size. This is known as an echinococcus cyst or hydatid cyst. Both terms are bad. "Hydatid" is from the Greek word for a vesicle of water. "Echinococcus" is from the Greek words for hedgehog and berry.

We are dealing here with the common form, the unilocular cyst, and not with the rarer form, the multilocular cyst. For the details of the formation of hydatid cysts I would refer you to some special treatise on parasitology, for instance, the recent work of Rivas.

It is not only the liver wich may become the seat of a hydatid cyst. Years ago Huber, of Bavaria, stated in the Twentieth Century Practice that the parasite is a cosmopolitan in the microcosm of the human body. It can settle, live, and prosper almost anywhere. In the liver, the lung, the bone, the brain, the muscles (including the heart), the spleen, the kidney, the prostate, the bladder, the testicle, the female breast, the mesentery, the great omentum, the uterus, the ovary, the mediastinum, the thyroid gland, the lymphatics, the arteries, the spinal canal. It is met with most frequently in the liver—next in the lung.

The disease is known to be rare in America, although a number of cases have been reported. Probably a fourth or a third of our cases are in recent immigrants from Europe who brought the disease with them, but various reports from slaughter-houses in the United States and Canada show that slaughtered animals are not very uncommonly affected with hydatid cysts, and such being the case, there is in slaughter-house refuse a fertile source for the propagation of the disease in this country. The disease is notably common in Iceland and very common in Australia. In Australia there are many times as many ruminant animals as there are men. In Iceland there are at least ten times as many sheep as there are men. In both countries there are great numbers of dogs.

Huber quotes Jonassen in emphasizing the danger that dogs may bring to man, and shows that a dog having thousands of tapeworms in his intestines passes each day numbers of ripe segments each one holding about five hundred eggs. The more careless and dirty a person is in handling dogs, the greater is his danger. The acme of carelessness is met with in Iceland. The dog lives in the house, in fact, in the kitchen, and frequently sleeps in the bed. There is no table, and platters for eating are laid upon the floor or in front of the fire. Drinking-water is kept very carelessly, and Huber has told us that the method of washing dishes is to have the dogs lick them clean. He further shows that dried herring is a very common diet in Iceland. The food is eaten almost raw after having been placed upon a stone on the floor and beaten with a hammer. The stone is entirely accessible to the dogs.

The disease is quite common in some parts of Germany, especially in Mecklenburg, and is not uncommon in France, in Italy, and in Switzerland. In England it seems to be decidedly more common than here. Wherever it exists, if not brought from without, we find the factors of the dog and flocks or herds, or adjacent slaughter-houses. In our country it is held that a dog eats slaughter-house refuse which contains the entrails of animals with hydatid disease. Suppose, for instance, that a dog was permitted at our clinic slop bucket after the performance of this operation for hydatid disease. As a result of eating the contaminated matter the dog could get tapeworm and the tapeworm of the dog can distribute the disease. One naturally feels like inquiring where it really started. It looks something like the old question, whether the egg came from the hen or the hen came from the egg. What is perfectly and immutably certain is this: a dog with tapeworm is a source of great danger to other dogs and to man.

A dog's appetite, like Sam Weller's knowledge of London, is extensive and peculiar. When he is on a walk he takes, in the words of O. Henry, "a leisurely inventory" of a multitude of things. It is no safeguard to the dog to be a beribboned and perfumed fluff from a scented boudoir. His appetite is as debased and his habits are as bad as those of a mangy, alley cur. If a dog acquires tapeworms he becomes a deadly menace. They may get upon food. They may get into drink. They may get upon the hands of one who pets and fondles the animal. They may be transferred by the dog kissing its mistress. I say its mistress, because most such infatuates are females; females who are so fond of dogs that they deny the existence of hydrophobia and, if they had heard about it, would deny the existence of hydatid disease. Such a person lives with a dog as a companion in bed and board, talks to it, kisses it, and fondles it. Perhaps, like Madame DeStael, the more they see of men the better they like dogs, but I have always strongly suspected that they have seen so little of men that they think too much of dogs.

It is usually held that more women than men suffer from hydatid disease. The reason seems obvious. Over one-half the cases are between the ages of twenty and forty, although the disease may occur in the early years of life or may not begin until extreme old age.

In some cases it seems as though traumatism had been a predisposing cause. This could only be by creating an area of least resistance. In some cases of hydatid cyst urticaria has occurred. In most cases when urticaria occurs the cyst has been tapped and there has been some leaking into the peritoneal cavity, or the cyst has ruptured, but in some reported cases there seems to have been urticuria without leakage. A history of urticaria in association with the signs presented by this man would greatly strengthen a diagnosis of hydatid cyst. When a person with a hydatid cyst has had an attack of urticaria he seems to be immune to future attacks.

A hydatid cyst may keep on growing until it attains an enormous size, may eventually rupture externally, into a body cavity, into a canal or channel. For instance, a hydatid cyst of the liver may rupture externally, into the peritoneal cavity, into the stomach, into the large intestine, into the pleural sac, or into the inferior vena cava. Rupture externally may be followed by cure. Rupture into the peritoneal cavity is very dangerous to life, and even if the patient survives, it may be followed by the growth of hydatids in the peritoneum. Rupture into the vena cava is quickly fatal. Suppuration may occur in a cyst. Some hydatid cysts with death of the echinococcus go on to suppuration. Suppuration is set forth as one of the dangers following tapping. If tapping were done aseptically the danger would be trivial. The danger of tapping is leakage rather than suppuration. Suppuration may arise by infection from adjacent intestine or may occur subsequently to necrosis of the cyst.

You observe in discussing the diagnosis of this case I did not advocate puncture or aspiration. It is true that the fluid if obtained might prove an aid to diagnosis. It has a significant chemical composition. It is a saline fluid with a specific gravity of 1.009 to 1.015, seldom contains albumin, contains at least 0.6 per cent. of chlorid of sodium, very small amounts of phosphates, calcium and magnesium carbonate and sulphates, sometimes succinic acid, sometimes uric acid, and usually dextrose. The microscope may disclose scolices or hooklets in hydatid fluid, but the fluid may fail to give us any certain information. In the fluid of a sterile cyst we will find no scolices or hooklets and in some cases the fluid contains pus or products of necrosis. I believe tapping to be not only uncertain and often useless but also a highly dangerous method, one always unjustifiable. The *x*-rays were used in this case and gave us some information. We have not employed serodiagnosis, as I have no knowledge of its status, and it seemed not worth while to delay to have it carried out. There is a precipitin test and a complement-fixation test.

We will now put this case to the final diagnostic test, which is exploratory incision.

We make a free incision of the abdominal wall. This exposes the large cyst coming from the under surface of the liver. It is bluish-yellow in color. Observe the gall-bladder upon it and in front of it. We make a coffer-dam of gauze about the cyst in case leaking should occur. The wound edges and the peritoneum must be protected from hydatid fluid because it might cause the growth of other cysts. We will now incise the capsule, and try to enucleate the cyst proper without opening it. We have, against our wish, broken into the cyst proper, the fluid is pouring out, and we are glad of our packing. The fluid is light colored, looks like typical hydatid fluid, and contains may daughter cysts. I now enucleate the cyst from the capsule and find that part of the cyst wall is necrotic. The query we naturally make is, Was the necrosis brought about by the *x*-ray? Frankly, I don't know.

The cyst contained almost 2 quarts of fluid. Numbers of daughter cells are floating in the fluid and many other daughter cysts are seen upon the walls of the enucleated cyst. Some of these daughter cysts are the size of acorns, others of pigeon eggs, others of walnuts. The connective-tissue capsule is now being sutured to the abdominal wall. Drainage of the cavity is necessary. The abdominal wound is now closed.

(The patient made an uneventful recovery. This is the fourth case that I have operated upon in the Jefferson Hospital in the course of thirty odd years. In one of these cases there was a huge hydatid of the muscles of the right thigh; in another there was a cyst of the liver presenting in front; another patient was suddenly seized with violent pain and jaundice, and operation disclosed the fact that a hydatid cyst had broken in the bile-ducts.)

PAGET'S DISEASE OF THE BONES (OSTEITIS DEFORMANS)

The patient is a colored women, fifty-two years of age, a native of Pennsylvania. She came to the hospital because of severe and persistent pain in the bones of the legs. Her father died of heart disease, her mother of Bright's disease. One brother was killed by accident. One sister and two brothers are living and well. She has worked for many years at lace work. She had the ordinary diseases of childhood, and inflammatory rheumatism in the ankles when a young girl. For six years she has been suffering from pain in the back. Her menses ceased six years ago. She had never had any miscarriages and has a child twenty-five years of age, who is in good health. She has never had venereal disease. Six years ago she began to suffer from aching in the bones of both legs. Neither of her parents and none of her grandparents suffered from anything similar. She has pain, particularly when she walks. It is sharp in character and she suffers even when lying down. The pain is particularly bad just below the knees. The muscles of the lower extremities feel constantly tired. She is weak and can walk but a short distance without exhaustion.

On examination of the back she exhibits a cervicodorsal kyphosis. She has no pain in the arms. The head is obviously enlarged, it being the shape of a triangle, the base of the triangle being at the summit of the calvarium and the apex at the point of the chin. This enlargement is symmetric and is bony. The bones of the face show no enlargement. The chest is deformed by curving of the ribs. The bones of the legs, particularly of the left leg, are felt to be enlarged, and so are the bones of the forearms. The Wassermann reaction is negative. The blood count shows a very moderate anemia, but is otherwise normal.

A guess at the diagnosis was hazarded from a mere glance at the head. This view was strengthened by the obvious thickening and curving of the tibiæ and by the bone pains in the legs. x-Ray examination confirms the diagnosis and shows typical bone changes in the skull, the humeri, the bones of both forearms, both femora, the pelvis, the lumbar and dorsal spine, and the tibiæ. The eye examination does not discover any signs of pressure or atrophy. The urine is normal, the heart is normal, and the temperature is normal.

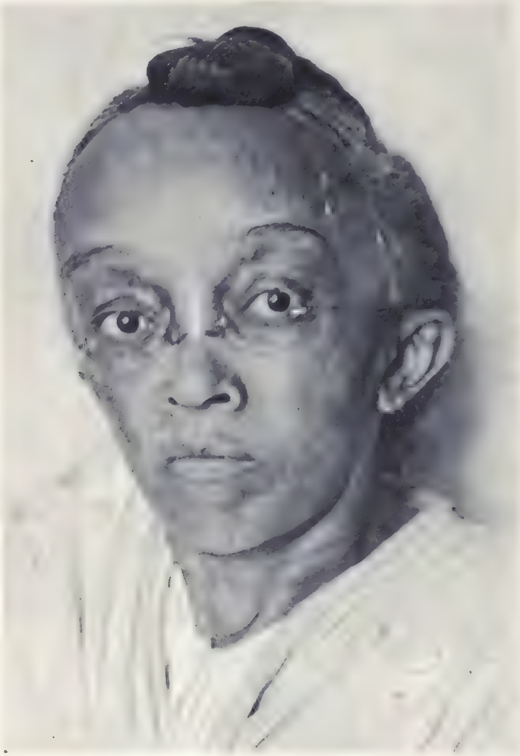


Fig. 11.—Paget's disease of the bones.

We have here a characteristic example of that strange and interesting disease, osteitis deformans, originally described by Sir James Paget in 1876. The name had been used by Czerny for a different condition as long ago as 1873. Before Paget's paper the term "osteitis deformans" was used for various conditions of bone disease with deformity. For instance: excessive callus, congenital deformity, bending of callus, bone syphilis, and various rickety deformities. Paget restricted the term to a special disease, and to this it is now limited. Paget called it osteitis deformans. It is commonly called, in honor of Sir James, Paget's disease of the bones. Don't forget to add "of the bones" to "Paget's disease," otherwise the term could be confused with Paget's disease of the nipple and areola. It is a rare disease, although I doubt if it is as rare as statistics indicate. Over 250 cases have been reported. The more carefully we are on a lookout for cases, the more of them we will discover.

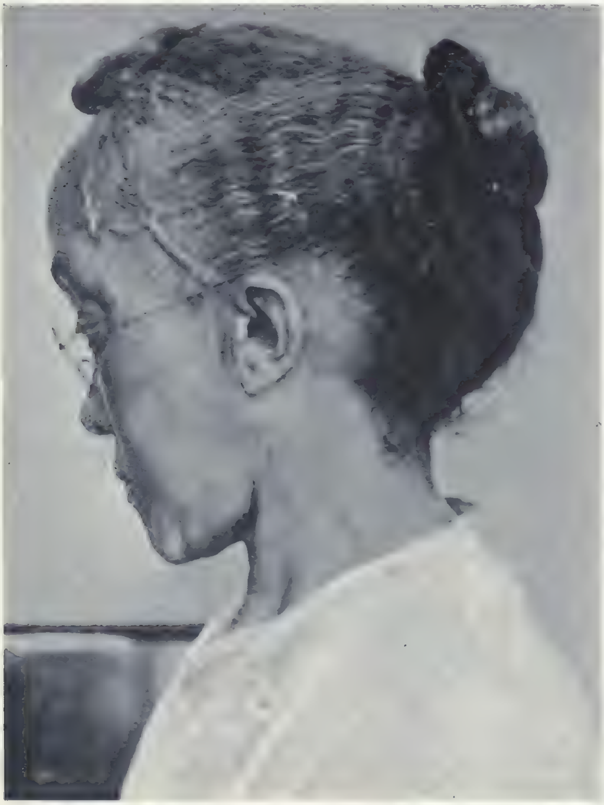


Fig. 12.—Paget's disease of the bones.

Many of them die of some intercurrent malady, the disease never having been recognized. Many never come to the hospital at all. Sometimes cases are discovered, they having come for advice for another trouble. For instance, Coppez, in the course of some years, found 4 cases of Paget's disease of the bones in an eye dispensary. In this, as in nearly all cases, the original diagnosis was rheumatism. If a person is watchful in walking about the poor and crowded neighborhoods of a great city he will now and then see a case of Paget's disease, usually in an elderly person who exhibits the attitude, the gait, and the enlargement of the head. Now and then the disease is discovered by the fact that the victim requires year after year a larger hat. Paget himself regarded the disease as a chronic inflammation of the bone. So do many present-day observers. It certainly is neither neoplastic nor hypertrophic.

Fig. 13.—Skull in Paget's disease of the bones.

Early in the disease the bone is so soft it can be cut with a knife, although in certain regions and especially late in the disease it may become extremely hard. The marrow space is soon invaded and may become entirely obliterated. Von Recklinghausen thinks that osteomalacia is the first change and that the bones bend because of the thinning of the bony cortex, and that inflammation arises in the regions of osteomalacia and causes the formation of fibrous tissue. Certain it is that the first obvious action of the disease is bone absorption which causes

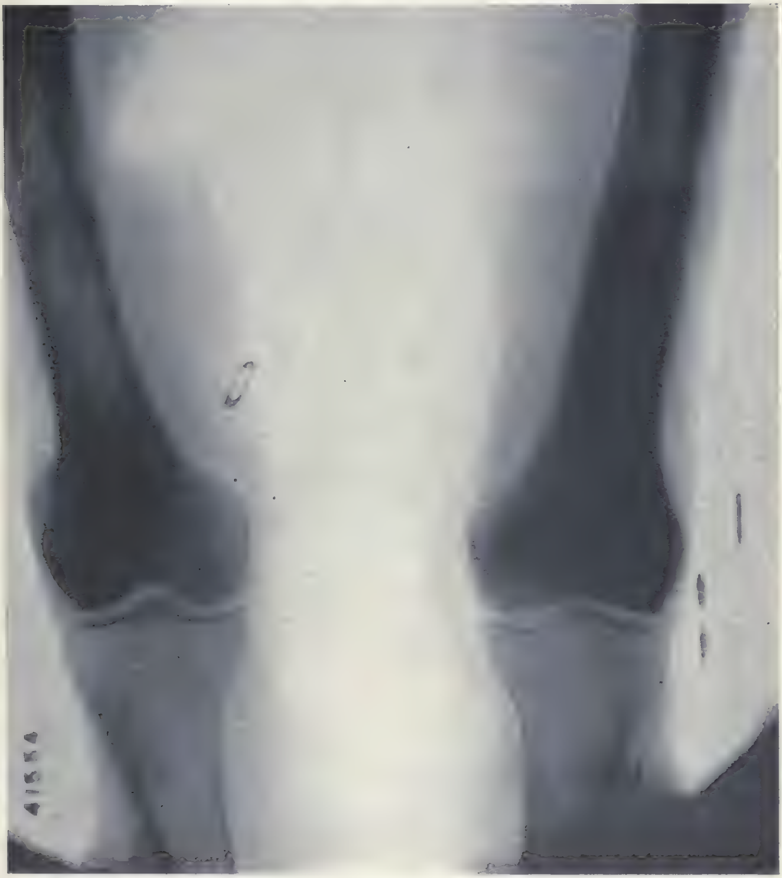


Fig. 14.—Paget's disease of the bones.

enlargement of the Haversian canals. The next step is the formation of new osteoid tissue. In many of these cases there is wide-spread arteriosclerosis, the nutrient arteries being also diseased. Locke has made a very clear statement of the essence of the process. He calls it a double one. First, old bone is absorbed; second, new osseous tissue is laid down. These two processes go hand in hand, although it seems highly probable that the resorption of old bone is the first step. Later new bone is deposited chiefly from the periosteum and to a slight degree from the medulla. The long bones of the extremities thicken and become the seats of pain. The bones of the lower extremities bend. This is partly due to the body weight. They also twist, so that the femur comes to look as though it had been grasped by

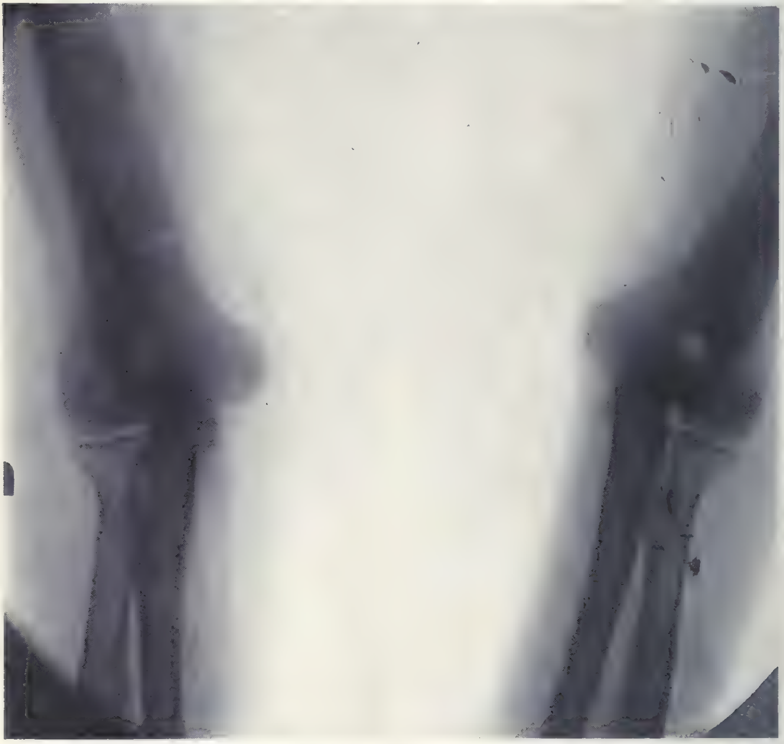


Fig. 15.—Paget's disease of the bones.

the hands of a giant, bent into a bow, and then twisted. That body weight is not the sole cause of the bending is shown by the fact that the bones of the upper extremities also bend, although to a less degree. The femur bends outward, the tibia forward, the bones of the forearm backward. The changes of osteitis deformans are not osteo-arthritic, although occasionally osteo-arthritis is seen as an attendant condition.

The bone changes usually begin in the bones of the legs, but may begin in the skull, in fact, in any bone. They start in one part of a bone, come to involve the entire bone, other bones, and eventually the whole skeleton. In some cases the condition remains long limited to one bone or even to an individual area of one bone. It may remain limited to one bone for years, and these cases are often very puzzling. In the great majority of cases a number of bones and finally practically all the bones become involved.

A characteristic feature of almost all cases is the enlargement of the skull. Some few cases never show it. These are undoubtedly cases in which we find no changes but in the skull. Most cases exhibit it sooner or later. In a number of cases it is the first sign observed, and in some few cases the skull is the only part affected, perhaps for months and even years. It is true that the long bones of the extremities suffer far more often than the other bones, the tibiæ being affected most commonly of all.

When the head alone is involved the question is, Are we dealing with leontiasis ossea (Virchow's disease)? Many observers regard this as a distinct disease limited to the face and cranium. Others consider it as a first stage of Paget's disease. In some cases of leontiasis ossea pagetic changes have afterward appeared in different parts of the skeleton. In cases of undoubted Paget's disease one side of the skull alone may be involved. Hence asymmetric deformity cannot be taken as a proof of Virchow's disease.

The bones of the hand and foot sometimes, though uncommonly, exhibit the changes of Paget's disease. In fact, the condition may begin there. The vertebræ are almost always involved, producing a cervicodorsal kyphosis, which greatly lessens the height of the individual. The lessening in height is accentuated by the bowing of the lower extremities. An individual may lose 6, 8, 10, or even 12 inches in height. One of Emerson's cases in Johns Hopkins' shrunk a foot.

There is no known racial predisposition or immunity to this disease.

It most commonly begins about the age of fifty, but it may start very much later or much earlier in life. In one reported case it was not observed until the age of seventy-nine. Cases have been reported as starting at the age of twelve, thirteen, fourteen, and sixteen, and in a case of my own the disease began at the age of nineteen. Cases have been reported as having had the head enlargement ever since birth.

The disease is of very long duration, lasting for years. One reported case lasted fifty-two years. It doesn't tend directly to shorten life.

Males are somewhat more liable than females. There are many reported cases in which osteitis deformans seemed to be a family involvement, and I am convinced that Paget's disease is a family disease in many of the patients. Some observers believe that there is a pathologic causal influence in acquired syphilis. Most observers deny it. Four-fifths of the cases, like this one, have a negative Wassermann reaction, and in some of the cases it was reported negative in the spinal fluid as well as the blood. In fact, a consistent positive reaction has never been found in an uncomplicated case. The clinical history of most cases is decidedly against syphilis as a cause, and the administration of iodid has no particularly beneficial influence.

Some of the reports of the French school, notably those of Fournier and Lannelongue, asert that Paget's disease is a late manifestation of inherited syphilis. They say that inherited syphilis and Paget's disease possess five elements in common. Both prefer the long bones, especially the tibia; in both the bone involvement is multiple; in both there is bone enlargement; in both there is prodromal pain, and in both there is deformity. The saber-scabbard shin was described years ago by Fournier as a lesion of inherited syphilis. In it the tibia is thickened in front and the crest is broadened from osteophitic growth, consequently the tibia becomes convex anteriorly. This seems to us a very different thing from the bowed tibia of Paget's disease. That Paget's disease has occurred in people with late hereditary syphilis is shown by a case reported by Fournier, but that it was due to the syphilis seems very unlikely. As a matter of fact, a feeble Wassermann reaction should never be taken as a proof of syphilis. If we examine a number of persons certainly non-syphilitic 30 or 40 per cent. will give a feebly positive Wassermann reaction. We must conclude that there is no proof that syphilis, inherited or acquired, is a cause. A neurotrophic cause is asserted by some. Degeneration of the nerves entering the nutrient foramina of bone is affirmed by others as causal. Gout, of course, has been blamed.

Several Italian scientists claim to have found a diploccoccus in the bone, and assert that they have found an identical diplococcus in the bone of osteomalacia. They prepared a vaccine and claim to have proved it serviceable. In 2 of my cases I removed a bit of bone from the tibia. Doctor Ellis made a careful study and found each piece of bone was sterile. Beyond the statement of the Italian scientists there seems to be no evidence that bacteria can be causal.

The popular and probable view is that increase, absence of or alteration in the character of the secretion of one or more of the ductless glands, is responsible for the metabolic changes characteristic of osteitis deformans. We know these glands have immense influence upon bone metabolism. We know that disease of the pituitary gland may be responsible for acromegaly, gigantism, and the bone lesions of cretinism. We know that the thyroid gland influences growth and tissue construction. We believe in the dominance of the parathyroids over calcium metabolism. Until a better theory is presented we will assume disease of a ductless gland or of ductless glands as the cause of Paget's disease.

In a very great majority of the cases of Paget's disease the first symptom is pain in the legs. After lasting for some months it may pass away. There may or may not be tenderness. The pain may be continuous or paroxysmal. It is aggravated by effort and may be so violent as to prevent walking. In some cases the pain has lasted throughout the whole course of the disease. Occasionally the leg pain is accentuated nocturnally. In a small minority of cases there has been no pain. The pain is particularly complained of in the lower extremities and not in the upper extremities or the head. The pain may appear months before bone disease is observed. It may not arise until the bone begins to bend. Severe pain will cause limping even before the onset of deformity. When the head is involved the deformity is striking and characteristic. The head becomes a triangle with the base above, when the enlargement is symmetric. The face is seldom affected below the supra-orbital margins, although the jaws sometimes suffer. Occasionally the enlargement of the head is asymmetric. The head may beomce enormous. The enlargement is due to immense thickening of the cranial bones. The greatest thickening is of the outer table, although the inner table thickens to some degree. Postmortem examinations show that the base of the skull also thickens and that the various foramina diminish in size. Changes in the bones of the base of the skull may produce pain and even palsy.

If there is great bony thickening of the face alone below the supra-orbital margins the condition is called leontiasis ossea. Such involvement of the face may cause severe pain and loss of function. In a case I saw in the Blockley Hospital blindness resulted.

The bones of the upper extremities may perhaps be involved early in the disease, as early as the bones of the lower extremities, but in the upper extremity the disease is not noticed so soon, because of the usual absence of pain and the later advent and slighter degree of deformity. In a large majority of cases the disease begins in a bone or in bones of the lower extremity, especially the tibia. There is first thickening and later bending. Usually one bone inaugurates the bending, the tibia or the femur, and other bones follow suit. Besides the kyphosis the chest is deformed and the pelvis is broadened. The chest deformity may be responsible for cough, chest pain, and dyspnea. The patient stoops and becomes very round shouldered. The head is jutted forward with the chin raised and it seems to be too heavy for its support. In a well-developed case, as Paget pointed out, the chest is sunk toward the pelvis, the belly is pendulous, the curved lower extremities are held wide apart, the knees are bent, the ankles overhang, and the toes are turned outward. The patient walks slowly and awkwardly in a tremulous and uncertain manner and requires the aid of a cane.

Fractures are uncommon, but occasionally occur. A fracture will undergo satisfactory repair. There seems rather a strong tendency to the development of sarcoma, probably because of the eccentric, inco-ordinate, and uncontrolled activities of the cells. Out of 159 collected cases of Paget's disease 15 showed multiple sarcoma.

Von Recklinghausen's disease (tumor-forming osteitis deformans, osteitis fibrosa cystica) was considered by its discoverer to be a definite malady, although a near relative of Paget's disease. Other observers regard the two conditions as identical. Cystic fibrous osteitis arises more commonly in the young than does Paget's disease, a majority of cases being in the second decade of life. Over 70 per cent. of them occur before the thirtieth year. Most observers regard this condition as being in close cousinship with Paget's disease. Kolisko considers fibrous osteitis and Paget's disease as identical. He says that in both bone-marrow is transfromed into fibrous tissue and in both there may be regressive changes leading to the formation of bone cysts or progressive changes resulting in giant-cell sarcoma. This view will be found in Ewing's masterly treatise on "Neoplastic Diseases."

The metabolic changes of Paget's disease, as set forth by my colleague, Professor Hawk, are of interest and probably of importance. They indicate a pronounced retention of calcium, magnesium and phosphorus, and a large elimination of sulphur. It may be that during the formation of new bone the osteoid tissue produces a highly sulphurized organic matrix which is gradually calcified by the deposition of calcium, magnesium, and phosphorus. In the course of the calcification a certain amount of the sulphur must be replaced by the other elements. Hence, the retention of calcium, magnesium and phosphorus, and the increased elimination of sulphur. This state of affairs is to a considerable extent the reverse of what we find in osteomalacia. Paget's disease is totally incurable. There is no proof of definite benefit from any plan of treatment. In some cases idoid seems to have somewhat mitigated the pains. In most cases it has done no good at all. It has been claimed that great pain in some of the long bones may be relieved by trephining the bone. I wouldn't hesitate to try the operation. An operation may be performed upon pagetic bones as on any other bone without any increased probability of infection and with equal certainty of sound repair. This statement is proved by the results of operations upon pagetic jaws.

We conclude that although Paget's disease appears to be a definite malady, it has close relationship to osteomalacia and very close relationship to and perhaps identity with Von Recklinghausen's disease, and with leontiasis ossea and hyperostosis cranii.

When the disease for a long period remains limited to one bone, it may be very confusing, as in the reported case where it was limited to one bone for over six years. As a rule, after a few months other bones are found to be suffering. It tends to become irregularly symmetric, but is not always so, and has nothing like the symmetric regularity of acromegaly. There is a very curious reported case in which only one side of the body was involved.

The *x*-ray is of the very first importance in diagnosis. It demonstrates cases of Paget's disease long before the deformity appears. It identifies the characteristic changes going on in the bone. It makes the diagnosis from all other bone conditions. All patients with bone pains should have *x*-ray pictures taken.

I am of the opinion that the mystery of the origin and nature of Paget's disease of the bones has the most chance of solution by prosecuting and carrying out further studies of the metabolic changes and of the action of the endocrins.

FRACTURE OF THE VAULT AND BASE OF THE SKULL, TEAR OF THE DURA, LACERATION OF THE CORTEX, AND HEMORRHAGE FROM THE POSTERIOR BRANCH OF THE MIDDLE MENINGEAL ARTERY

There are only two possible opinions about the police force, namely, the opinion the public holds of the force and the opinion the force holds of itself. The public is not inclined to the view that policemen are qualified surgeons.

From the history of the patient before us we learn that some policemen regard themselves as surgeons. This case will illustrate the distinguished surgical abilities of our gifted police. Policemen have been taught just enough emergency surgery to make them presumptious, self-confident, and highly dangerous.

> " A little learning is a dangerous thing;
> Drink deep or touch not the Pierian spring. "

The patient before you is a man thirty-five years of age, an automobile mechanic by occupation. Several days ago he was found unconscious upon the pavement, was picked up by a policeman, and was taken to the station house. He recovered consciousness in a short while, but was dazed. His answers were confused, he knew nothing of how, when, or where he was hurt, and had no memory of a period embracing a number of hours before the accident. There was no cut upon the scalp, no epistaxis, no bleeding from either ear. He gave off a strong odor of liquor. That distinguished surgeon, the Sergeant of Police, made an examination and called in consultation that eminent diagnostician, the Lieutenant. Their views coincided and their diagnosis was "pure drunkenness." In a philanthropic spirit the police had the victim taken home. The next day, my chief assistant, Doctor Shallow, was called in to see him. Doctor Shallow had him removed at once to the hospital, and later I saw him. He was dull, heavy, verging on stupor, but not unconscious. The pupils were equal, normal in size, and reacted normally to light. The pulse was 60 and the respiration was normal. The arm and leg of the left side were weakened, but not absolutely paralyzed, and every now and then waves of tremor swept over them. In the course of a few hours these parts became the site of violent convulsive movements. The face was slightly but certainly drawn to the right. We believed we could feel a fracture of the parietal bone. The *x*-ray showed a fracture running from near the midline into the base of the right side. There was no hemorrhage from the nose, the nasopharynx, or the ear, and the ear examination showed there was no bulging of the drum, so we concluded that the basal fracture was not compound into the nasopharynx or the middle ear. Battle's sign was absent (ecchymosis over the mastoid process) and there was no subconjunctival hemorrhage. The eye examination showed some fulness of the retinal veins, but no choked disk. Spinal puncture showed some increased pressure and the cerebrospinal fluid was bloody. The pulse was 60 and the temperature was normal. It was evident that this man had a fracture of the vault of the skull which ran into the base, and that an injury to the brain had caused subdural hemorrhage and that he was slowly developing compression. The slow development of compression suggested a slow meningeal hemorrhage between the dura and the bone, a hemorrhage from a branch of the vessel rather than from the main trunk. Doctor Shallow trephined on the right side 1¼ inches back of the external angular process on a level with the roof of the orbit. He could see there a very thin edge of a clot which was extending forward from a considerable hemorrhage more posterior. The hemorrhage was not from the main trunk or the anterior branch of the middle meningeal. A piece of the inner table of the skull had been broken off, had penetrated the dura, and was sticking in the cortex, a lesion responsible for the blood beneath the dura and perhaps for the spasms of the opposite side of the body. This piece of bone was removed. There was no active hemorrhage from the pia. The dura was sutured. Doctor Shallow, feeling that the thin edge of clot he saw was the anterior edge of a larger clot, proceeded to trephine below the parietal eminence in order to reach the posterior branch of the middle meningeal. There he found the source of the hemorrhage. A very large currant jelly clot was removed and the bleeding from the vessel was arrested by a piece of packing. This patient was laboring under a very slow meningeal hemorrhage. If such an amount of clot had formed quickly the man would have become comatose very soon, but as it formed slowly the brain had time to more or less adjust itself to the pressure, and heaviness and dulness had not yet given way to coma. Evidently had the surgeon not operated the bleeding would have continued, the clot would have enlarged, the pressure would have increased, the man would have become comatose, and would have died of respiratory failure. The operation has undoubtedly saved his life.

You remember the typical course of a case of uncomplicated meningeal hemorrhage. The original injury, the probable, although not necessary, unconsciousness and the temporary nature of unconsciousness unless there are grave associated injuries. The fact that a definite period of consciousness intervened between an accident and the symptons proper of a hemorrhage is of the very first importance in diagnosis. There is a gradual development of the symptoms of compression as I have outlined above. The original unconsciousness is due to concussion and the unconsciousness of concussion is always temporary unless there be grave associated injuries, like laceration of the brain, contusion of the brain, or profuse hemorrhage. The unconsciousness from pure concussion may last minutes or an hour or so, but it is always transitory. The essential nature of the phenomena of pure concussion is that they are all transitory. The patient reacts from concussion and has an interval of consciousness until the gradual enlargement of the blood-clot begins to cause compression. The interval of consciousness deceives many observers. It helped to deceive the police. The police regarded the smell of liquor on the breath as highly significant, but it is well to remember that a sleeping bishop after a Christmas dinner might smell of liquor. Those of you who have read "Great Expectations" will remember that Joe Gargery, the blacksmith, knew this. Though perfectly sober, he would run home from the tavern with his mouth open in the hope that the air would rinse out the smell before he reported to his formidable wife. Not unusually, a man who has been hurt has liquor given him as a restorative (or at least used to have before these moral days now upon us). This man was unconscious when found, so we admit that he had liquor before his accident. We don't know how much liquor. We don't know what his accident was. He might have fallen and struck his head. He may have been struck by one of the numerous desperadoes who at present infest Philadelphia with apparent immunity from capture. His loss of memory embracing a number of hours before the accident strengthened the police view as to drunkenness. They regarded the loss of memory as conclusive evidence of drunkenness.

A very common thing after a head injury is for a person to have some form of loss of memory. Memory consists of several elements, viz., perception, registration, reproduction, and localization in the past. These are the elements according to Ribot. If the image on the retina never reaches the brain center it is not perceived, and what is not perceived cannot be registered. It is extremely uncommon for a person to remember an accident which renders him unconscious. The reason being that it is very unusual for registration to take place. The time between the accident and the unconsciousness is usually too brief to permit of it. If a person tells you he doesn't remember anything about the accident, and then afterward tells you he does remember about the accident, the latter statement is beyond any question a falsehood. It is quite impossible to recover a memory which never existed; and if the events of the accident were never registered, they can never be recollected. Reproduction means the bringing into consciousness of something that was registered, and its localization in the past means the ability to tell whether the event was an hour ago, a week ago, a year ago, or years ago. A senile dement shows inability to localize in the past. He mixes up the events of boyhood with the events of today. Inability to localize in the past means a useless memory. I have seen this form of amnesia follow a head injury. The loss of memory for a period preceding the accident means the inhibition of the reproduction of impressions, of things that have been registered. It is the common form of amnesia after a head injury. It may embrace minutes, hours, days, months, years, or an entire lifetime. It is a condition that may be permanent, but in many of these cases a partial or complete memory is sooner or later recalled, the inhibition upon the reproduction of registrations having ceased. It is, therefore, not at all unusual and not in any sense proof of drunkenness that this man smelt of whisky and that he had lost his memory of all occurrences during a number of hours before the accident. You can see that our patient has had a very narrow escape. If the police had followed the imperative orders of the Chief of Police Surgeon in regard to such cases, they would have sent for the District Surgeon to come to the station house and examine the man. He would have recognized the gravity of the situation and have sent the patient to a hospital.

I cannot insist too strongly on the importance of this case. Once in a great while, I am ashamed to say, a like piece of stupidity is exhibited in the accident room of a hospital. The resident physicians in our accident ward have imperative orders that a man who has struck upon his head or has been struck upon the head must not be allowed to leave the hospital for a day or two for fear that hemorrhage may be occurring or may subsequently occur. Such a happening in a police station is bad enough, but in a hospital it would be an infinite disgrace. The man, drunk or sober, must not leave the hospital until we are sure that his condition is safe.

LETHARGIC ENCEPHALITIS MISTAKEN FOR MENINGEAL HEMORRHAGE

THE patient is a boy of twelve who was struck upon the head with a football two days ago. He was knocked down. Is said to have been unconscious for a minute or two. He got up, feeling dazed, and soon after went home. The next day the family noticed a difference in him. He didn't make any attempt to run out and play or see the other boys. He didn't want to talk. He had some headache and seemed very sleepy, constantly dropping off to sleep. Today he was brought here. He has a temperature of just below 101° F. His pulse is over 80 and soft. His pupils are equal, normal in size, and contract to light. The eye-ground when examined by the Professor of Opthalmology was found to be normal. When shaken or pinched he can be roused to intelligence and will answer questions clearly, falling back at once into somnolence when the questioner ceases to interrogate. The legs show a slight tendency to Kernig's sign, but there is no Babinski reflex and no evidence of paralysis. A spinal tap shows no indications of pressure. The spinal fluid contained a normal amount of glucose, but 80 lymphocytes to a field. A most significant thing is that when the boy is roused he complains of double vision, and the opthalmologist reports to us that there is paralysis of the superior oblique in each eye; that is, the muscle supplied by the fourth nerve. The Wassermann reaction is negative.

The significant facts in this case are that the boy after an injury developed lethargy, elevated temperature, and ocular palsy, without a sign of cerebral compression. The physician who first saw him very naturally, in view of the injury, believed that the boy was getting a meningeal hemorrhage, but there are no signs of compression. The cerebrospinal fluid is not ejected with force during the puncture. The pulse is not the pulse of compression and the condition is not one of stupor verging on to coma, but a condition of lethargy from which we can rouse him temporarily to full consciousness.

We regard the injury here as having been entirely casual or perhaps as having stirred into immediate activity organisms which were already present in the brain. We diagnose this case as lethargic encephalitis. It is a curious disease and is becoming not a very rare one. It is due to an inflammatory condition arising in the midbrain, especially about the locus niger, the gray matter of the Sylvian aqueduct and of the fourth ventricle, a process which may spread to the optic ophthalmi and the corpora striata, or to the pons variolii and the medulla oblongata. It might be said that the large number of cells in the spinal fluid sets aside this diagnosis. I do not think so. This case is tending to assume the meningeal form as shown by the slight Kernig's sign. In such a case there may be numerous lymphocytes.

It is not my province as Professor of Surgery to discuss the subject of lethargic encephalitis. That is done by my colleagues, the Professor of Practice of Medicine and the Professor of Neurology. I do want to say, however, that the triad of symptoms we have mentioned is most significant; that is, lethargy, ocular palsy, and fever. Furthermore, we should know that there are numerous different types of lethargic encephalitis, that one type is perhaps mistaken for brain tumor, another type for brain abscess, another for uremia, another for diabetes, etc.

The essential character of the lethargy of encephalitis, the character which differentiates it from coma, is that the patient can be roused to answer questions intelligently and can be made to take food. Neither of these things is possible in coma.

It may have happened to others, but it is certainly new to me to have meningeal hemorrhage added to the various things with which lethargic encephalitis may be confused.

We refer this case to my colleague, Professor Dercum.

(Professor Dercum tells me that the boy was treated by repeated spinal punctures. After the second tap the lymphocytes and the slight Kernig's sign disappeared. In three weeks the boy was well.)

PULSATING CENTRAL SARCOMA OF THE LOWER END OF THE HUMERUS

The patient is a man forty-six years of age, a street car conductor by occupation. Before the accident this man felt perfectly well and had not suffered from any pain in the extremity. About seven months ago, while standing, he was jolted and grasped the back of a seat with his left hand. His arm was violently wrenched and he also knocked his elbow. The doctor who examined him said that his arm was broken and put it up in splints. The doctor also said that he could feel crepitation when he pressed upon the part. An *x*-ray was taken, but it is said it failed to show a fracture. Whether it showed anything else we have not been able to find out. The splints were worn for several weeks and when they were removed the elbow was somewhat stiff. The man discovered a small tender lump on the inner side of the lower end of the humerus. This lump has grown progressively until it has attained the size that you now observe. It approaches the hemispheric in outline. It feels elastic, in fact, almost soft, and some parts of it are firmer than other parts. It pulsates distinctly. It is not the violent pulsation of an aneurysm of a large vessel, but a pulsation which is a sort of vibration or thrill. On listening with a stethoscope a blowing sound is heard. The skin over the mass is freely movable and exhibits some large veins. The mass itself is firmly attached to the bone and also to the fascia and muscle outside of the bone.

There is pain, although no severe pain. On movement the part is somewhat tender. The *x*-ray picture does not indicate any former state of fracture. It shows a central growth which has perforated its bony shell. It is possible to assume that when the doctor examined this man after the accident he felt the egg-shell crackling of thin, expanded bone over a tumor mass.

We are dealing here with a tumor of bone which either existed at the time of the accident or has resulted from traumatism. The rapidity of growth, the condition of the bone, the great size of the mass, the pulsation, and the bruit all indicate that we are dealing with a malignant tumor. The first inquiry necessary to be made is whether the mass is a secondary or a primary tumor. Is there any seat of tumor growth in the body which might have been the source of such a secondary tumor? We know that cancer is never a primary disease of bone and that it attacks bone by infiltration (as when a breast cancer destroys the ribs or sternum), by lymphatic distribution (as when the head of the humerus becomes diseased secondarily to a breast cancer), or by embolism. Cancer of the thyroid gland, of the prostrate gland, and of the mammary gland are particularly apt to cause secondary bony deposits. Cancer anywhere can be responsible.

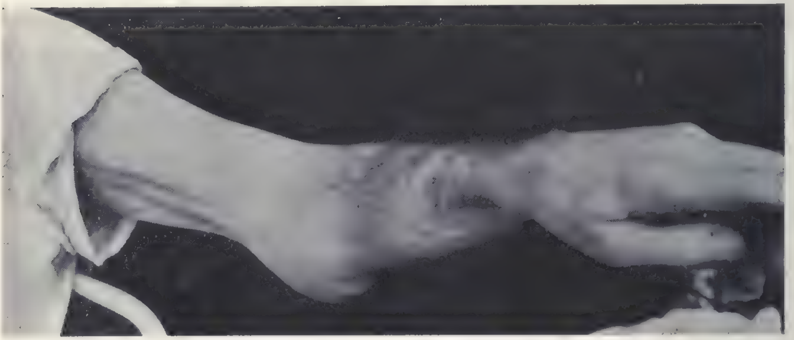


Fig. 16.—Pulsating central sarcoma of the lower end of the humerus.

Not uncommonly fracture is the first sign of a secondary bone cancer. A number of bones are apt to be affected, but one bone may suffer for a considerable length of time. Cancer of the thyroid is particularly apt to cause bony deposit, and if the thyroid growth is small it can easily escape recognition. It is said that a thyroid deposit in bone may arise from a small goiter. Such a deposit is apt to pulsate. A secondary hyponephroma may arise in bone and that is apt to pulsate. In this case a careful examination fails to disclose any evidence of a primary focus which could furnish bone disease, as in the case before us.

In order to be sure of our ground in reaching a diagnosis of primary tumor of bone the various bones of the skeleton should be studied with the *x*-ray. If we find multiple lesions the chances are strongly against their being sarcoma (although they may be), and we would be in all probability dealing with that curious and fatal malady—multiple myeloma. In primary bone neoplasm the urine does not show Bence Jones albumin. In multiple myeloma it does show it. This form of albumin is not precipitated by nitric acid except after standing, and a pre-

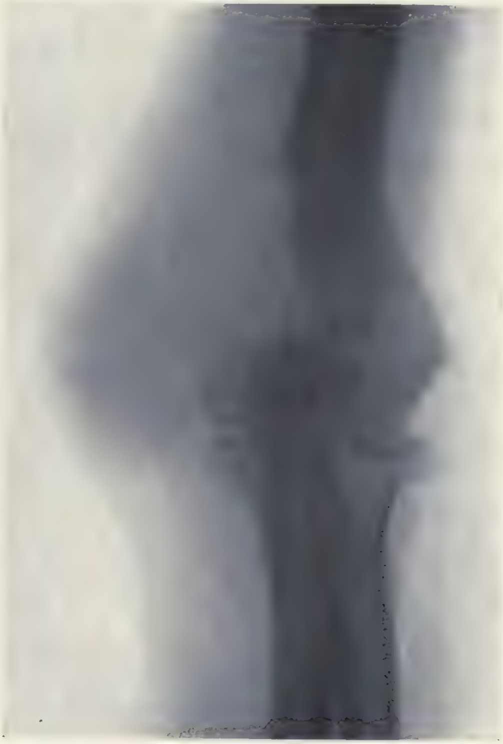


Fig. 17.—Pulsating central sarcoma of the lower end of the humerus.

cipitate thus formed is dissolved by boiling. We therefore conclude that we are dealing with a primary tumor of bone, malignant in character, hence with a sarcoma. It is a well-known fact that injury may be the exciting cause of sarcoma. Gross says there is a history of injury in half the cases (a blow, a fall, a twist, a wrench, a break, or a sprain). In other cases the first strong suggestion of a sarcoma may be a pathologic fracture or a fracture from slight force. This may occur in a periosteal sarcoma. It is particularly apt to occur in a central sarcoma. According to Bloodgood's studies pain is bound to precede spontaneous fracture in central sarcoma. This man had no pain before his accident. As the *x*-ray picture shows a central sarcoma, we assume either that the accident broke the thin bony shell of an existing tumor, or that the traumatism inaugurated the tumor.

In this man there are no significant blood changes. There is no evidence of lymphatic involvement and we are dealing with a central tumor that has broken through its shell. Now, what kind of tumor is it? Can it be a giant-cell growth, one of those growths which is practically benign and which is curable by a local operation? This growth is too rapid for a giant-cell sarcoma and Dr. Bloodgood writes me, in answer to a query, that he had never seen pulsation in a central giant-cell sarcoma. He says he has seen it once in giant-cell sarcoma of the periosteum. Personally, in my much smaller experience, I have never seen pulsation in any periosteal sarcoma. We are dealing here evidently with a real malignant tumor—round cells, spindle cells, or perhaps mixed cells. The type of growth is what is commonly called a bone aneurysm and what Bloodgood well names a malignant bone cyst.

Sarcoma of bone is one of the most malignant of neoplasms and the records of operative treatment are truly ghastly; although malignant bone cyst shows far better results than other forms. Bloodgood shows that amputation cures less than 4 per cent. of periosteal sarcomas, that the results are only somewhat better in central sarcoma; that in malignant bone cyst practically one-third of the cases may be cured. The point that must at once be determined in this man is whether or not there are pulmonary metastases. Sarcoma is distributed by the blood rather than by the lymph. Pulmonary metastasis occurs sooner or later in nearly all cases. Frequently it occurs very early. If metastasis exists, the patient is doomed. No treatment for it is of the slightest avail and it is simply mutilation to practice radical surgery for a sarcoma of the extremity if the lungs are already involved. We direct that this examination of the lungs be made at once.

Bloodgood in his classical study of 370 cases of bone sarcoma tells us that diagnosis is often more or less uncertain, that amputation must never be performed until a diagnosis of malignancy is established, and that an exploratory operation may be necessary to confirm the diagnosis. It might be possible in this case, if pulmonary metastases are absent, to undertake an operation by resecting and bone-grafting. In the upper extremity this would be particularly worth trying, but if it were found not to be possible, amputation ought to be performed. So our future procedure is to be as follows:

First, the *x*-ray picture of the lungs. If the lungs are found clear from sarcomatous nodules, make an exploration of the tumor and remove a portion of tumor tissue for laboratory study. After the removal of this portion of tissue we will again follow Bloodgood's advice. We will cauterize the wound with the actual cautery or with a 50 per cent. solution of chlorid of zinc in order to kill aberrant cells and prevent rapid growth of the disease. If our diagnosis is confirmed we may then undertake a resection, obtaining the man's permission beforehand to amputate if we find it necessary. (This man has obstinately and persistently declined to have even an exploratory incision made, and therefore we will be compelled to use radium needles.)

In this arena I speak of sarcoma of bone with a rather particular interest, because my old Master, the late Professor Samuel W. Gross, was immensely interested in it, and in 1879 wrote a classical article upon the subject in the American Journal of the Medical Sciences.

There have been written three most notable articles on this subject in the last sixty years. That of Nélaton in 1860, that of Gross in 1879, and that of Bloodgood, of Johns Hopkins, in 1919. A most striking article upon the subject, the best of pathologic articles in any text-book, is that of James Ewing, of New York City, in his book upon Neoplastic Diseases.

(Examination made later by Dr. Manges showed the lungs strewn with sarcomatous nodules.)

PRESENILE SPONTANEOUS GANGRENE

We present a man born in Galicia, thirty-two years of age, a storekeeper by occupation. About a year ago this man began to suffer from severe pain in the right foot and calf of the leg when very tired or exposed to cold. Soon after he began to exhibit like phenomena in the left foot. The attacks became more and more frequent and more violent. Every now and then on rising from a chair, getting out of bed or walking, he would have such very violent pain that he was forced to sit down immediately, even if he were in the street. This condition was intermittent claudication. He then noticed that when he hung his feet over the edge of the bed that the toes and dorsum of each foot grew purplish red and looked swollen, a condition the neurologist calls erythromelalgia. A few days ago black spots appeared on the great toe, two of the other toes, and the dorsum of the right foot. He is now completely crippled by pain and has come to us for advice. As I move the extremities you see the spots of dry gangrene. As I ask him to sit on the edge of the bed and hang his legs down you see the purplish-red engorgement of the toes and feet and that he complains of violent pain. As we raise the extremities to the horizontal the color quickly disappears, leaving a mottled whitish appearance. There is no pulse in the dorsalis pedis or the posterior tibial arteries of either extremity; in fact, I cannot feel a pulse in either extremity until the examining fingers reach the popliteal, so it is evident that those large arteries are blocked.

What disease are we dealing with? It is that disease which Professor Buerger, of New York, has done so much to illuminate, which he called presenile spontaneous gangrene and which he says is thrombo-angeitis obliterans in the large arteries and in the deep veins of the leg. Inflammation arises. Clots form. The clots become canalized and vascularized. Connective tissue forms and is largely devoid of elastic fibers. The condition probably begins in the artery with occluding thrombosis. Evidently fibrous tissues forms in large quantities. The artery, vein, and nerves adhere and violent pain is the consequence. In cases of long duration arteriosclerosis will be found. In all probability the inflammation is due to some unknown infection. In this disease if the clot forms slowly and the collaterals develop distinctly gangrene will not occur. If the clot forms rapidly and the collaterals are in poor condition gangrene will occur. Mayesima points out that in this form of gangrene there is increase in the viscosity of the blood. Just as oil will run through narrow tubes less easily than water, so viscous blood will run through narrow vessels less easily than thinner blood. Blocking will occur more easily when there is increased viscosity of blood than when there is not.

This disease occurs particularly between the ages of twenty and forty. I have never seen a case in a man over fifty. It is said not to occur at all in women. Some think female immunity is due to the internal secretion of the ovary which protects the female sex. I have seen one woman apparently suffering from thrombo-angeitis which had not gone on to gangrene. It is not limited to Jews, but an enormous majority of the patients are Russian, Galician, and Polish Jews in our large cities. An exactly similar form of gangrene is known to arise after typhus fever. Some have tried to attribute to indoor work the blame for the disease. Some have laid it to excessive use of the legs, some to unlimited cigarette smoking, and some to a diet of salt meat, but none of these alleged causes can be proved.

It usually but by no means invariably begins in the left leg. In the case before you it began in the right leg. It may begin nearly at the same time in both legs. If it begins in one leg the other is almost certain to become affected sooner or later. It comes on with attacks of violent pain in the toes, foot, or leg. Early in the case the extremity lacks pulse and whereas when the person is free from pain the pulse may be felt it cannot be felt during the pain. After a little while the pulse disappears altogether. The attacks at first are caused by cold or effort, later they arise spontaneously. The claudication and the erythromelalgia are typical. These patients become exhausted from the violent pain. In most cases sooner or later gangrene occurs. It may occur in a few months, but it usually doesn't occur for a year or more. In one of my cases I amputated the leg above the knee. At a later period the other leg above the knee, and later still reamputated the extremity which was first operated upon. A few weeks later the man died, probably from involvement of the renal vessels, and at that time there was beginning gangrene of the hands.

All sorts of things have been tried in treatment. Two things are necessary. First, to lessen the viscosity of the blood, and second, to enlarge the collaterals. Ringer's solution given by hypodermoclysis frequently causes great abatement of the pain, sometimes seems to lessen the tendency to gangrene, and to lead to a line of demarcation. It is injected daily or every other day for fifteen or twenty times, and then, after a wait, another series of injections is given.

Doctor Steele, of Philadelphia, and others have had greater success by the intravenous injections of a 2 per cent. solution of citrate of sodium, 250 c.c. at a dose. During the first month the injection is given every other day, during the second month every third or fourth day.

Persistent heating of the extremity with electric bulbs at a temperature of 110° F. is the best means for enlargement of the collaterals. During the first month the patient is kept in bed and the heat applied continuously. This plan of treatment if carefully handled may prevent gangrene or may lead to the arrest of gangrene which has once started.

If a definite line of demarcation forms we can gradually separate the dead parts. If no definite line of demarcation forms, the one possible treatment is amputation above the knee. You may well ask me why not remove the blocking clot. The answer to that question was given by Bernheim a few years ago. He said it is not possible to remove the clot surgically because the material constituting the block is organized and adheres to the wall of the vessel, and furthermore, the veins contain clot. Again, you may ask me why not perform the operation of reversal of the circulation. The answer to that is evident. The veins also contain clot, and hence we cannot deviate blood from a blocked artery into an unblocked vein, but only from a blocked artery into a blocked vein. This would be stupid and perhaps harmful.

This is an extremely interesting disease, increasing in frequency, and in which the discovery of the cause might lead us to the cure.

I trust that some of you in the future will give special time to its investigation.

CLINIC OF DR. JOHN G. CLARK

UNIVERSITY HOSPITAL

PROLAPSUS UTERI; ULTIMATE RESULTS IN 100 CASES

It is our purpose today to take up the consideration of the various phases of prolapsus uteri. A short time before the Great War began a distinguished German professor stated that as yet no fully satisfactory method had been developed for the treatment of proplapsus uteri. From my personal observation of clinical work in Germany and the United States I am convinced that American gynecologists have been very much ahead of the Germans in developing the best operative methods for the treatment of these anatomic defects. In order to ascertain the ultimate results in cases treated by the various procedures which we have pursued my associate, Dr. Charles C. Norris, and I have made an intensive study of 100 cases. The careful collection of the clinical statistics and the analysis of the cases have been made by Dr. Norris. Many points in surgical technic which we have found most effective have been suggested by my other associates, Dr. Anspach and Dr. Keene. We feel, therefore, that the methods employed are more or less composite and represent the combined efforts of the staff of the Gynecologic Department of the University Hospital.

We are under the greatest obligations to Dr. William P. Graves, of Harvard, for the loan of his excellent drawings depicting these plastic operations, which appear in his Text-book on Gynecology. Only those phases of our work which have been found most useful, some of which are original, others, modifications of standard methods, have been illustrated. Other methods, the descriptions of which have hitherto appeared in gynecologic text-books, have been employed as seemed indicated, but have not been described for the obvious reason that they are accessible for study in their original sources of publication.

Within the last few years many different operations for the cure of proplapsus uteri have been suggested, and the ultimate results have varied considerably in the reports of several writers. Because the results of our efforts of eight or ten years ago were not so satisfactory as we desired, we revised our operative technic, modifying from time to time some points and adding others, hoping thus to overcome the errors observed in our earlier series of cases. This evolution in the treatment of these cases has been followed by a decided improvement which we attribute to these changes in viewpoint. Formerly our efforts were directed toward correcting a lacerated perineum, a relaxed pelvic floor, or a uterus in varying degrees of descensus; now we treat these cases as varying degrees of hernia.

All forms of prolapse of the uterus, vagina, bladder, and rectum are but varying stages or phases of a hernial problem. There is no operation that will invariably be adapted to all these cases, and there is no policy, therefore, that so jeopardizes uniform success as an adherence to a one-pattern plan of operation. So long as the operations of Emmet, Hegar, and Tait were accepted as fixed and unvarying standards, there was a wide range between an ideal functional restoration and a relatively large proportion of disappointing results.

In our earlier surgical treatment of prolapsus cases we advocated the Emmet principle in perineal operations in conjunction with an oval anterior colporrhaphy which was followed in turn by a suspension operation—usually the method of Kelly in younger women, and fixation of the uterus to the anterior abdominal wall in older women. This plan of treatment yielded satisfactory results in many cases, but the percentage of recurrences was sufficiently large to render a complete revision of our methods of operation necessary in order to assure a larger and better surgical output. This phase of our work is now regarded by us as a valuable transitory experience that has carried us forward into a much more secure surgical field in which the final results are more uniformly satisfactory.

The Emmet perineal operation has been abandoned and we have substituted a modification of the Hegar operation.

For our inventory of ultimate results we have chosen 100 consecutive cases which have been checked up either by personal interview and examination or by letters to patients and their home physicians. No case has been included in which less than a year has elapsed since the operation.

Before considering our present plan of treatment we must say a word as to our evolution from former to present standards of procedure. For several years we not only practised the Emmet perineal operation, but taught that this was the last word in plastic surgery as applied to the posterior vaginal wall. When, however, we carefully reviewed our more remote postoperative results, we discovered that in this we were in error, for, although this operation proved successful in a large percentage of cases of simple rectocele, in those of more extensive type and in prolapse of the uterus the method was ill adapted to meet the conditions that caused the prolapse. Its greatest defect lies in the fact that the crest of the rectocele and the hernia in the higher reaches of the vagina are not corrected. Similarly, any type of suspension operation that attaches the uterus to the anterior abdominal wall is also based upon a fallacious principle.

A prolapsus is a hernia of the uterus in which Douglas' culdesac is a chief propagating factor. Merely, therefore, to repair the external exit of this hernia—the vaginal outlet—by a plastic operation and to suspend the offending organ leaves the chief intermediary part of the hernial tract, Douglas' pouch and the upper portion of the vagina, still untouched. Under this plan, therefore, recurrences will be too frequent.

To Moscowitz and Frank, of New York, we are especially indebted for calling our attention to the tremendous hernial possibilities of Douglas' culdesac. Indeed, we are in full accord with Moscowitz's belief that this pocket is a potent cause in the propagation of a prolapse of the rectum, and it is the ultimate factor in the production of a complete procidentia uteri after the initial descensus of the uterus occurs. With the uterus descending in midposition or retroflexion the intra-abdominal impact is directed into Douglas' culdesac, after which the hernial sac is thrust downward, driving a wedge between the rectum and the vagina. Complete prolapse is then a matter of a relatively short time. It becomes quite obvious, therefore, that, to restore these cases successfully to normal health, the hernia interposed between the rectum and the upper part of the vagina must be obliterated.

For analytic purposes the cases of genital prolapse may be grouped as follows:

A. Pseudoprolapsus uteri, in which there is a hypertrophically elongated cervix projecting from the vaginal outlet, with or without an accompanying cystocele or rectocele, the body of the uterus nevertheless occupying essentially its normal position in the pelvis. In these cases the anatomic variations are much less extensive than in a partial or complete prolapsus, and the surgical principles of treatnent are, therefore, correspondingly simpler and the final results uniformly satisfactory.

B. Partial prolapsus uteri, in which the cervix appears at the vaginal outlet and is associated with a cystocele and rectocele alone or in combination. In this class we are usually dealing with three herniæ, involving the rectum, the bladder, and Douglas' culdesac, the uterus appearing as a projecting mass.

C. Complete prolapsus uteri, in which the uterus is enclosed in a hernial sac, Douglas' culdesac, completely outside of the vaginal outlet, associated with a more or less extensive cystocele and rectocele (vesical and rectal herniæ).

In Group A, pseudoprolapsus uteri, it is obvious that amputation of the cervix and efficient repair of the cystocele and rectocele will effect a perfect result. In Group B, partial prolapsus, the same procedure may effect a cure. It is especially in this class of cases—in women who have passed the childbearing period—that we perform a type of Watkins' operation before undertaking the perineal operation. In younger women, after completing the perineal operation, instead of inverting the uterus beneath the bladder, we usually open the abdomen and shorten the round ligaments according to the Coffey plan. In our earlier cases we considered this procedure sufficient to accomplish the purpose, but in an occasional instance the functional result was not satisfactory because we neglected to shorten the uterosacral ligaments—in other words, we failed to overcome this hernial tendency in Douglas' culdesac. With our revised methods in all those cases in which there is a decided descensus of the uterus we shorten the uterosacral ligaments by plication on the posterior surface of the uterus at the cervicofundal juncture, according to Bovee's plan, thus restoring the restraining function of this set of ligaments. In rarer cases, if Douglas' pouch tends to form a considerable hernial pocket, this also is obliterated by plication with catgut sutures, as suggested by Moscowitz, after which the round ligaments are shortened according to the Coffey plan.

In a few cases we have performed the Baldy-Webster operation, but, because of its frequent failure to give symptomatic relief, we have long since abandoned the method, for, while the uterus may be restored to a normal position, the patient often complains of a dragging sensation in the pelvis. We attribute the failure to obtain relief to the fact that either through direct tension or through possible adhesions or cicatrices forming at the site where the ligament perforates the broad ligament direct pressure is made upon the utero-ovarian circulation, thus giving rise to congestive disturbance. In an analogous manner a boy on crutches may be suspended clear of the ground, but his arms will suffer as a result of pressure on the axillary vessels. The Coffey plan of shortening the round ligaments, on the other hand, has been uniformly satisfactory.

In the C group, in women beyond middle life, we usually perform first a vaginal hysterectomy, and then, following the Charles Mayo plan, pull the broad ligaments well down into tension and, after they are stitched together, anchor them in the vaginal vault in such a way that, when released, they spring back into the pelvis, pulling up the vaginal fornix, thus holding it in secure suspension. Before doing this, however, frequently we take advantage of the opening in Douglas' pouch to obliterate the deeper part of this space by plaiting it together with running catgut sutures. This procedure effectively blocks a large hernial impulse which otherwise predisposes to a postoperative prolapsus of the vaginal fornix and an ultimate eversion of the vagina. Since adopting this method of procedure we have seldom found it necessary to perform a celiotomy in these cases. In 3 cases in 100 in which Douglas' culdesac was very greatly pouched and situated well outside of the vaginal orifice we followed the plan of Moscowitz; the patient was placed in an exaggerated Trendelenburg posture and the uterus drawn high up into the celiotomy incision, thus making it possible by placing successive layers of catgut stitches to obliterate Douglas' culdesac, after which a partial hysterectomy was performed and the round ligaments were then implanted in the cervical stump. In some cases a panhysterectomy was necessary, in which case the round ligaments were implanted in the vaginal closure. In obliterating Douglas' pouch Moscowitz has warned against the dangers of including the ureters in the stitches; for this reason they should be located by touch or sight and carefully shielded from hazard during the peritoneal plication. Fortunately, the necessity for this rather extensive and slightly more hazardous operation is seldom necessary, as the foregoing plans are adapted to at least 98 per cent. of even the exaggerated cases.

In the surgical treatment of a simple rectocele or cystocele no operation which does not go deeper than the skin coverings of these sacs will succeed. For this reason a simple oval denudation and suture in any type of cystocele will almost invariably fail. In a cystocele we deal with three factors: first, the bladder as the hernial sac; second, the subvesical or pubocervical fascial webbing; and, finally, the vaginal musculature and skin. While the bladder can neither be excised nor deeply plicated, the sagging or broken interposed fascia between it and the vaginal wall may be restored by a carefully applied suture. Likewise the broken interposing fascia between the rectum and vagina can be brought back to its barrier-like integrity. The simple perineal part of these operations is merely the concluding step of a hernial operation in which the external outlet, like that of the external ring of an inguinal hernia, is restored to normal. In the posterior operation, the modification of the Hegar type, as evolved in our clinic, effectually carries the repair, if necessary, quite up to the cervix, permitting the operator to reach the interposing culdesac and suture it in such a way as effectively to preclude its further participation in the vaginal hernia, or rectocele. In two steps of the operation we are under obligation to our associates, Dr. B. M. Anspach and Dr. F. E. Keene, for their suggestions. To the former for the use of a subcutaneous stitch in the final steps of the perineal operation; to the latter for suggesting that all of the stitches be inserted from the vaginal surface, thus doing away with the usual crown stitches which appear on the perineal surface. These additions to our technic have added to the success of the operation and greatly to the comfort of the patient. The gradual approach to well-established principles in plastic operations in our clinic is, therefore, the cumulative result of associated endeavor. There is little of originality in this work, for, as noted above, in many clinics we find the same principle in vogue with merely variations in operative technic. Our illustrations will depict the operative steps, and we shall not therefore enter into a detailed description of technic. In the study and analysis of the after-results in these cases I am indebted to my associate, Dr. Charles Norris, who has been indefatigable in his search for the good as well as the bad points in our work.

ANALYSIS OF SYMPTOMS

While the work of the gynecologists has pointed the way to the surgery of the upper abdomen, this, in turn, in its achievements has demonstrated the errors of so-called gastric reflexes emanating from pelvic sources. Acute or chronic symptons in the upper abdomen are rarely if ever of reflex origin. If we required any convincing proof of this statement, a review of symptomatology in our 84 cases would furnish convincing evidence against this fallacy. In this entire number there were only 6 patients who complained of indigestion, and of this number, 3 had gall-stones removed during the course of the operation for prolapsus. The chief symptoms were directly attributable to the pelvic disability. The one paramount fact which is most patent is that gastric disturbances and general nervousness are the least frequent of all of the patient's complaints. In the order of frequency the symptomatology is recorded as follows in 84 cases:

Presence of mass	70
Pain in lower abdomen	28
Leukorrhea	27
Backache	21
Frequency of urination or incontinence	27
Dysuria	22
Pain on urination	18
Headache	6
Menorrhagia or metrorrhagia	15
General lassitude	7
Pain on defecation	1
Nausea	2
Indigestion	6
Nervousness	5
Dysmenorrhea	2

In conjunction with the prolapsus uteri the following associated pathologic conditions were noted which unquestionably participated to a greater or less extent in this symptom-complex:

Cholelithiasis	5
Appendicitis or peri-appendicitis	5
Myoma uteri	6
Hemorrhoids	7
Complete tear	4
Prolapse of rectum	2
Hernia	5
Pelvic inflammatory disease	1
Vesical calculus	1

A preconceived opinion as to recurrences has not been sustained by our review of cases. We believed, when we started this review, that our percentage of recurrences or imperfect results would fall within the years after the menopause, first and naturally because the majority of cases falls within those years. In our series of cases 66 per cent. were forty-five years of age or over; the decade between fifty-five and sixty-five years of age furnished 37 per cent. Due to this fact we expected to find our unfavorable results falling within these later years, but such is not the case, as our few failures bear no relationship to the age of the patient. One very evident clinical fault is all too obvious; that is, these patients usually have gone entirely too long without surgical help. Only 7 cases have come to operation within one year after the appearance of the prolapsus. In 37 other cases the interval between the appearance of the prolapsus and the operation has been between four and twenty-five years. In a few cases they had not previously consulted a physician, but the great majority had either been advised by the family doctor to let matters alone, or had been tided over with some form of pessary. Too often that ugly fallacy, encompassed within the statement, "Wait for your menopause, and you will get well," is dealt out to these patients. While the results of these operations, contrary to our preconception, have turned out as well after as before the menopause, certainly with the progressive increase in the size of the prolapsus, the extent of the operation is much greater, and, to say the least, postoperative morbidity is proportionately higher.

For the correction of associated pathologic conditions the following operations have been performed: appendectomy, 17; cholecystectomy, 3; hemorrhoidectomy, 8; herniorrhaphy, 5; salpingectomy, 10; removal of cervical polyp, 1; myomectomy, 2; Webster's operation for diastasis recti, 2. In this entire series there has been no death.

TYPE OF OPERATIONS

Because of the many factors entering into the etiology of these herniæ it is obvious that no one type of operation is applicable to all cases. Many anatomic variations render necessary a special surgical adaptation of measures to each case. Upon a careful individual study of each patient success depends. In the series of cases utilized for this study the following operations were employed:

Clark's modification of Hegar's operation, 79; Emmet's operation, 3; anterior colporrhaphy, 65; dilatation and curetage, 50; trachelectomy, 50; trachelorrhaphy, 8; Coffey suspension of the uterus, 12; ventral suspension of the uterus, 3; Baldy-Webster suspension of the uterus, 3; ventral fixation of the uterus, 7; Watkins' interposition, 30; vaginal hysterectomy, 15; supravaginal hysterectomy, 8; operation for complete laceration, 5; partial vaginal hysterectomy, 2; plication of uterosacral ligaments and peritoneum of Douglas' culdesac combined with some other suspension operation, 3; excision of prolapsed vaginal stump, 2; fixation of cervical stump to lower angle of abdominal wound, 2.

An analysis of the above list shows that either the fundus or the entire uterus was removed in 21 cases; vaginal hysterectomies, 14; supravaginal hysterectomies, 17. Some variety of intra-abdominal suspension of the uterus was performed in 23 cases; Coffey suspension in 11, ventral suspension 3, ventral fixation 6, Baldy-Webster suspension 3.

Thus the uterus was either removed or suspended in 44 cases and Watkins operation was performed twenty-eight times. In other words, the uterus was either removed or suspended in every case except those in which the Watkins operation was utilized. The larger number of hysterectomies have been performed during the latter period of our series, since we have adopted the plan of utilizing the ligamentary attachments of the uterus for the support of the vaginal fornix. Perineorrhaphies were performed on all cases, all but 3 being Clark's modification of the Hegar operation. Anterior colporrhaphies were performed fifty-five times; as a matter of fact, anterior wall operations were probably performed somewhat more frequently than this, but were not noted on the operation blank. This operation is performed routinely in all Watkin's operations. In each case the analysis has been made according to the operation stated in the histories.

In nearly all supravaginal hysterectomies the stump has been suspended by fixing the round ligaments into the cupped-out cervical stump. In some cases, in addition to this, either the ends of the infundibulopelvic ligaments, or, in cases in which the adnexa were conserved, the proximal tubal ends and part of the broad ligament have been included in the cervical stump. In only 2 cases the cervical stump (after an abdominal hysterectomy) has been fixed to the abdominal wall. This statement is confirmatory of our theory that this procedure is to be avoided except in very rare instances.

The results of our questionnaire and examination of cases of this series show that, while the anatomic results were, on the whole, good, the symptomatic results were even better. In none of our series of cases has there been any mortality and the morbidity has been slight. It has been our experience that practically all cases in which plastic operations are performed on the anterior vaginal wall require catheterization; in some this condition lasts for one day only, while others are unable to void for two, three, or even more days. When catheterization has to be resorted to for more than twenty-four hours the routine administration of urotropin has usually been resorted to as a prophylactic measure against cystitis. When possible it is advisable to have these patients practice urination while in the recumbent posture for a week or two prior to operation. In all cases we employ catgut sutures. In 2 or 3 cases there has been postoperative bleeding, probably due to premature absorption of the suture material, which has been controlled easily by a vaginal tampon. We also have had a few cases of infection. This is especially likely to occur in extensive anterior wall operations unless particular attention is paid to hemostasis.

Notwithstanding an occasional focal infection, in no case has it been sufficient to necessitate a secondary operation, and its influence upon our final results has been almost negative. For a short time we used a continuous buried suture, but this has the disadvantage, if an infection occurs, of a more extensive impairment of the wound than when the interrupted sutures are employed. In the first instance the suppuration is confined to the deeper tissue; in the latter it more quickly finds an exit.

SUMMARY OF ANSWERS TO THE FOLLOWING QUESTIONNAIRE

1. Have you been benefited by your operation?

Cured, 70; greatly improved, 7; improved, 5; not improved, 2; worse, 0. One patient has been completely cured of prolapsus, but has had a very serious nervous collapse, which has made her an invalid. Three patients answered "improved," but from the remainder of the answers in the questionnaire they are apparently cured.

2. Have you had any frequency or pain on passing water? Yes, slight, 6; no, 68.

(*a*) If so, how often do you have to pass water during the day? Six patients, eight to twelve times.

(*b*) If so, how often during the night? Nine patients, two to five times.

(*c*) How soon did it appear after operation? Immediately, 8; one year after, 2; soon after, 10.

(*d*) When did it disappear? Still present in 9 cases. Present for one year, 1.

3. Have you been able to control the bladder since operation? Yes, 78; no, 4.

(*a*) If not, when did this symptom appear? Immediately, 3.

(*b*) When did it disappear? In three or four months, 1; still present, 2.

4. Has there been any falling of the womb since operation? Yes, slight, 8; no, 76.

(*a*) If so, is it as large as before operation? Yes, 1; no, 7.

5. Has there been any undue (abnormal) bleeding from the vagina since operation? Yes, 0; no, 82.

6. Have you had any pain or discomfort in the operative region? Yes, 3; no, 74.

(*a*) If so, how soon after operation did it appear? Immediately, 3. Only 3 patients answered this question.

(*b*) Is it now better, worse, or has it disappeared? Better, 3.

(*c*) Describe the pain. Soreness in lower abdomen, 2. Pain in vagina, 1. Only 2 patients answered this question.

7. Is your general health better than before operation? Yes, 77.

(*a*) How was your health before operation. Good, 8; fair, 22; poor, 47.

No patient has had a second operation since leaving the University Hospital.

One patient operated upon five years ago was, according to her husband's statement, cured, but died two years ago from goiter. Another patient was reported by her physician as cured, but died two years after her operation from hyperthyroidism and auricular fibrillation. One patient was pregnant at the time of the receipt of the questionnaire. Another one has had 2 children since operation; she reported that she was cured and there had been no recurrence. Of the 100 cases selected for study we failed to trace 14.

CONCLUSIONS

1. Cases of prolapsus uteri should be treated upon a hernial basis in which Douglas' pouch, the rectum, and the bladder participate as protruding sacs into a weakened vaginal canal the vault of which becomes a primary point of weakness. It is easily explainable, therefore, that a simple perineal operation with an associated suspension of the uterus, or with a hysterectomy, will frequently fail because the essential weakness in the upper part of the vaginal canal, both anteriorly and posteriorly, is overlooked and the correction of the primary hernia in Douglas' culdesac is not, therefore, effected.

2. To overcome the surgical defects of previous years the broken or weakened fascial layer and muscles making up the septum between the vagina and the rectum are now corrected by extending the usual perineal operation high up into the vagina, even to the cervix.

3. Suspension or fixation operations, as applied to the uterus, will frequently fail because the hernial pocketing in Douglas' culdesac is not corrected, as a result of which the continuous drag in this area leaves the patient still uncomfortable or may lead to a recurrence of the prolapsus.

4. In complete prolapsus of older women a vaginal hysterectomy with attachment of the broad ligaments to the upper

vaginal extremity, or a supravaginal hysterectomy, with these ligaments applied as inserts into the cervical stump, with plication of the dependent Douglas' pouch, is most efficient.

5. In younger women, within the childbearing period of life, the utilization of the uterosacral ligaments plicated upon the posterior wall of the uterus at the cervicofundal junction, followed by some form of shortening of the round ligaments, with us preferably the Coffey plan, is almost invariably successful.

6. The interposition operation (Watkins) is the method of choice in women beyond the menopause when the cervix descends only to the vaginal outlet. Of late we find the interposition operation of less necessity if there is performed a trachelectomy followed by a careful anterior colporrhaphy. The effectiveness of the latter procedure depends upon the restoration of the weakened area between the lower third of the uterus and the vesical wall. Here the hernial tendency is very pronounced, and, if this area is not blocked, a recurrence is probable. In the correction of the cystocele especial care must be observed in dissecting free the subvesical fascia and utilizing it as a suspensory sling for the support of the bladder. In all of this work the chief factor lies in the restoration of weakened or disrupted fascial supports.

ILLUSTRATED STEPS OF PLASTIC OPERATIONS APPLIED TO ANTERIOR AND POSTERIOR VAGINAL WALL

The following drawings illustrate the important steps of plastic operations for cystocele and hernia of the posterior vaginal wall as performed in the Gynecologic Clinic of the University Hospital. Special stress is laid upon the importance of restoring the fascial supports of the vagina and the uterus as a primary requisite for success in any method of treating prolapsus uteri. No attempt has been made to depict the various established methods of treating the prolapsed uterus which we have employed in our series of cases, as they have been repeatedly illustrated in various medical periodicals and text-books. To these sources the reader may turn for information as to their methods of execution.

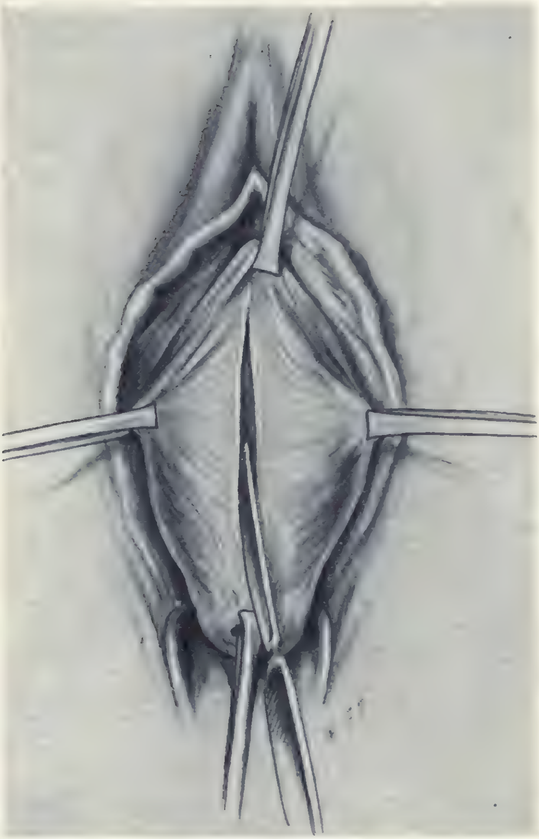


Fig. 18.—The cystocele is pulled well down to the vaginal outlet with a tenaculum applied to the cervix. In incising the anterior vaginal wall care should be observed not to cut through the underlying fascia. With a sharp knife or scissors the fascia is dissected away from its skin attachment, or it may be pushed upward with the finger enveloped in a gauze sponge.

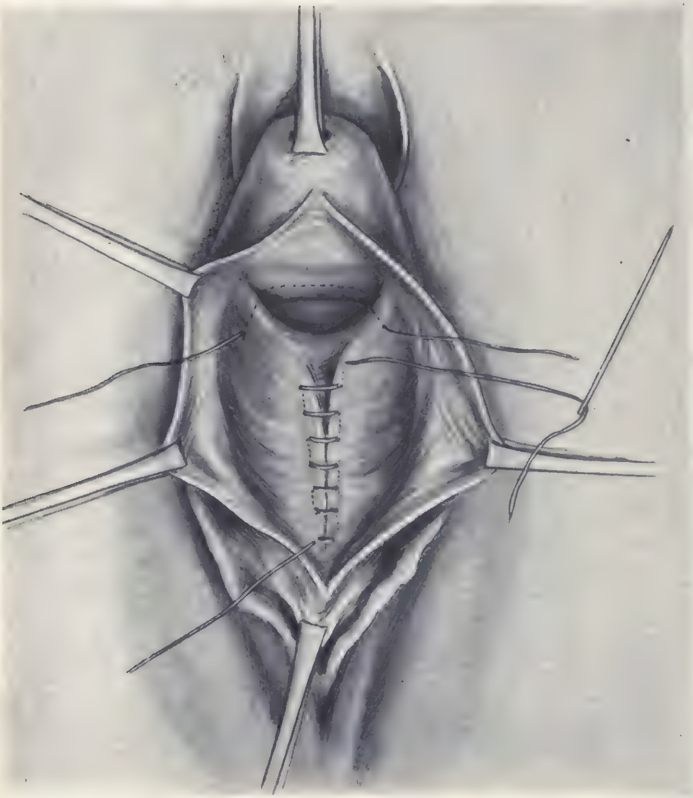


Fig. 19.—The fascia has been freed from its skin attachment. The pillars of this fascial layer which swing around the cervix have been detached, and the bladder, as a hernial sac, has been pushed up underneath the fascia. A continuous catgut suture (No. 1) has been carried down to the pillars, but at this point a No. 2 chromicized catgut is caught in the lateral borders of the ascial pillars, carried down into the anterior cervical wall, and firmly tied, thus effectually placing a barrier against this weak point. The No. 1 continuous stitch is then carried up to its point of insertion, thus further infolding the sagging fascia.

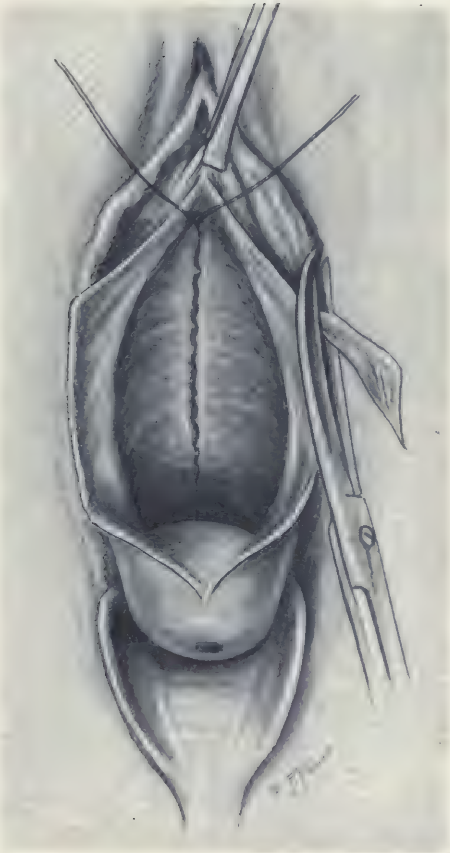


Fig. 20.—The fascial stitch completed. The white area on the anterior face of the cervix represents the point at which the vesical fascia has been detached and shoved up on the face of the uterus.

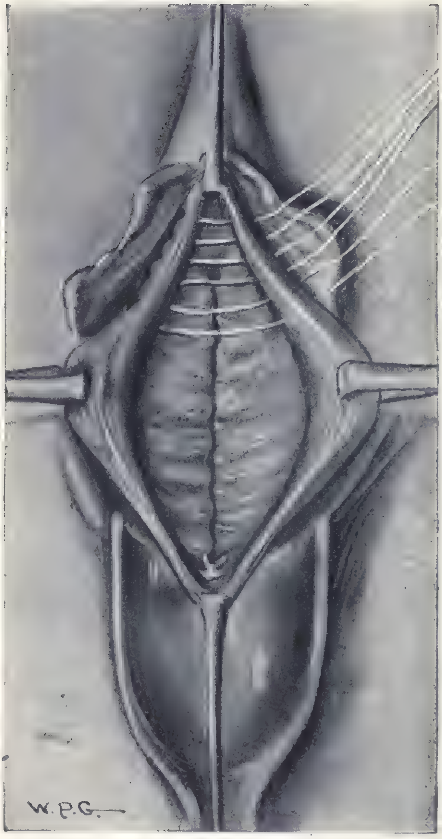


Fig. 21.—Two plans have been followed in closing the skin covering the cystocele, either mattress sutures, such as illustrated here, or simple interrupted sutures of No. 2 chromicized catgut are applied. After the completion of this step, a row of fine catgut approximation sutures are employed to bring the skin surface into neat apposition. (Graves.)

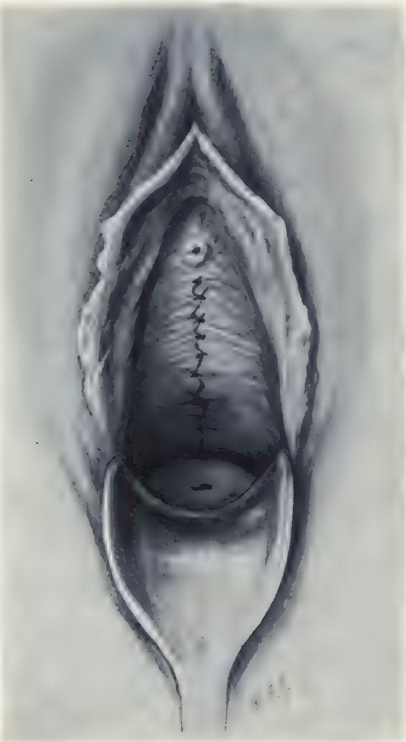


Fig. 22.—The anterior vaginal wall as it appears with the colporrhaphy completed.

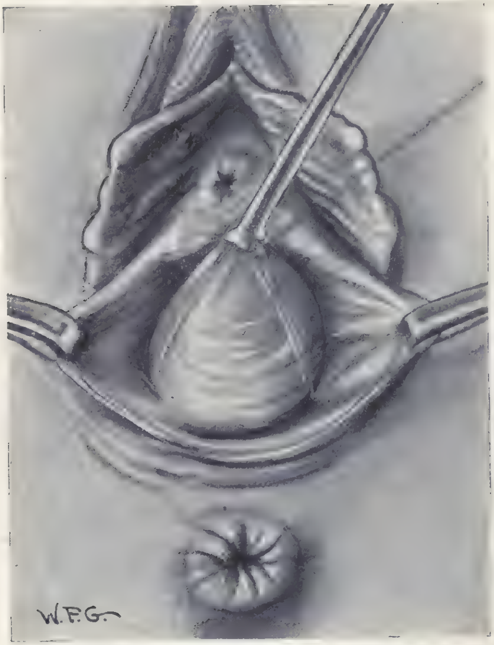


Fig. 23.—Two points are essential in defining the area of skin denudation, first, the incision is carried from the perineal face to the base of the rectocele, thence upward as a superimposed inverted Λ beyond the point of bulging in the vagina. By the first maneuver undue narrowing of the vagina will be avoided, and by the second the higher reaches of the vagina, from which the hernia begins, will be laid bare. (Graves.)

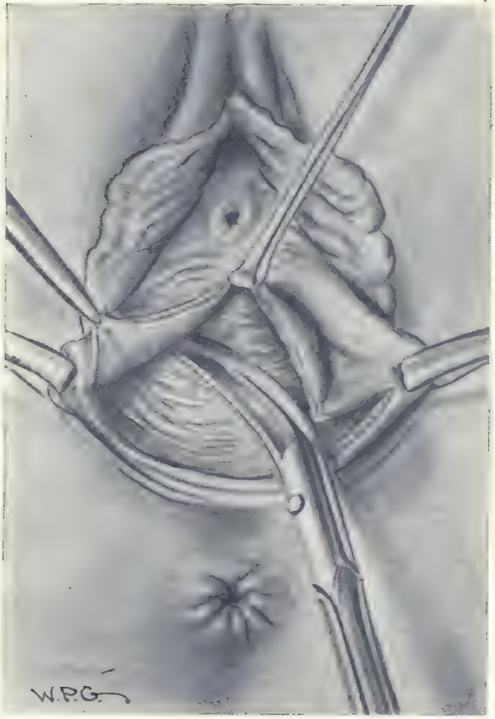


Fig. 24.—The skin denudation is completed, the fascial plate between the rectum and the vagina being exposed. Precaution is observed not to cut through this plate, otherwise the perirectal fat will be exposed and unnecessary bleeding may occur. (Graves.)

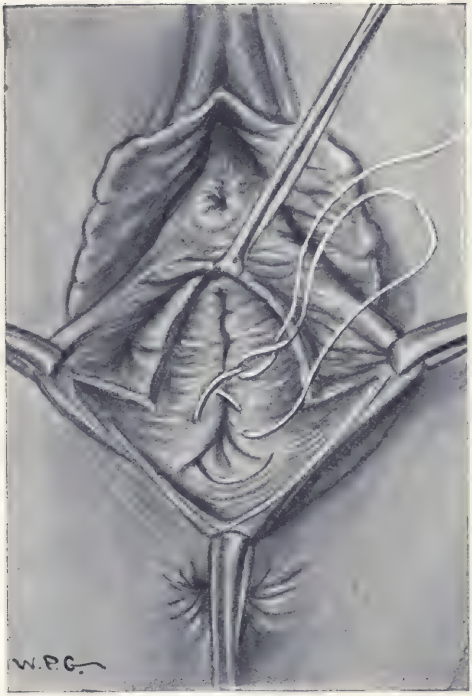


Fig. 25.—Either a No. 2 continuous chromicized catgut suture is applied from the top of the exposed fascia down to the vaginal outlet, or, as usually executed, deep interrupted catgut sutures are inserted, thus bringing into snug apposition the lateral fascia and musculature. By this means a firm rectovaginal septum is restored high up in the vagina, even to the cervix, in exaggerated cases of hernialization. (Graves.)

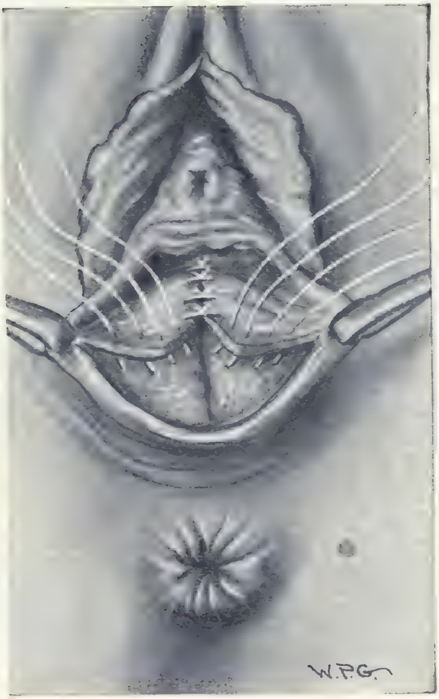


Fig. 26.—Interrupted sutures applied to bring into close apposition the skin covering the fascia. The purpose of the triangular flaps in the vagina is here illustrated. Through this step cicatrization and ultimate narrowing of the vagina with the possibility of dyspareunia is avoided. (Graves.)

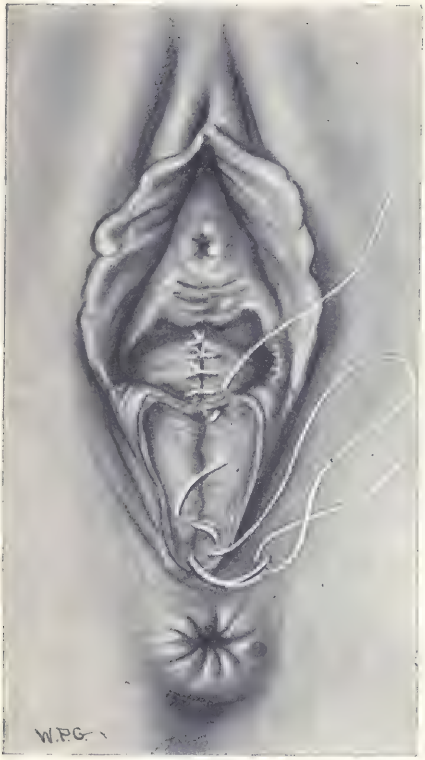


Fig. 27.—The subcutaneous catgut suture (No. 1) is inserted just within the vaginal orifice and carried down over the face of the perineum, first bringing into snug apposition the superficial perineal fascia; on reaching the lower angle of denudation it returns as a true subcutaneous suture to the opposite side of its insertion. (Graves.)

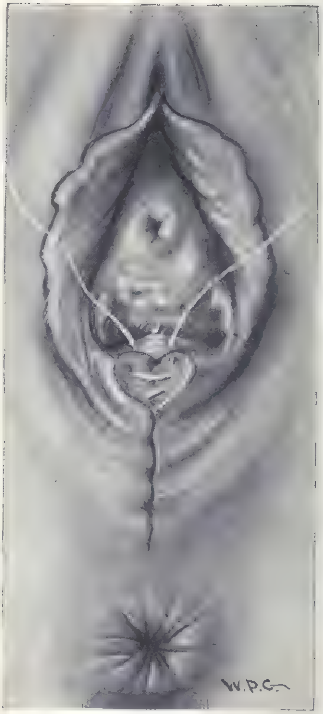


Fig. 28.—The perineal fascia and subcutaneous stitch completed and ready to tie. (Graves.)

CLINIC OF DR. CHARLES H. FRAZIER

UNIVERSITY HOSPITAL

A CLINICAL LECTURE ON TRIGEMINAL NEURALGIA

By way of introduction let me remind you of the origin and distribution of the trigeminal nerve. You recall its sensory root originates in a nucleus in the pons, passes forward toward the apex of the petrous bone, where a small opening in the tentorium is provided, from which it emerges in the middle fossa to enter the ganglion of Gasser. I want to remind you too that the motor root of which we will have something to say later lies just beneath the sensory root, but passes behind the ganglion to join its third or mandibular division. Now if you will look at this skull you will see the postition occupied by the gasserian ganglion in the cavum Meckelii and it has several important relationships that are of practical significance. Note the position of the foramen spinosum through which passes the middle meningeal artery; in this skull it is to the outer side and a little posterior to the foramen ovale. This is not a constant relationship, however, as the foramen sometimes is as far forward as the foramen ovale, so that as one approaches the foramen ovale in operations upon the ganglion or its sensory root the middle meningeal artery must be divided before the third division, which makes its exit through the foramen ovale, can be approached.

In close relation with the inner margin of the ganglion are the third, fourth and sixth cranial nerves, and the cavernous sinus. The proximity of this structure was a matter of concern to the surgeon when excision of the ganglion was the conventional operation for the treatment of trigeminal neuralgia, and not infrequently one or the other of these structures was injured in the course of that operation. You will learn later that this operation has been abandoned and the proximity of these structures is now a matter of no practical concern. The gasserian ganglion is enclosed in a special envelope which we call the dura propria, which in the course of the operation must be divided before the ganglion or its sensory root is uncovered. I want you to note, too, the general position of the ganglion in the middle fossa, and you will see that the most direct approach to the ganglion is from the middle of the zygoma or a little posterior to that point.

You will remember that the function of the trigeminal nerve is predominantly sensory; of its three main divisions, only the third or mandibular has any motor representation, supplying the temporal, masseter, and pterygoid muscles. In this chart you see the territory supplied by the three divisions—the ophthalmic, maxillary, and mandibular. The left trigeminal territory, as a whole, is flanked on its mesial surface by the zone of the right trigeminal nerve and on its posterior and inferior surface by the zone of the cervical nerves. Only one of these boundaries, however, is constant, namely, the mesial; the inferior and posterior have considerable variation in different subjects. Not only is this the case, but in the mesial aspect there is never any overlapping of function, while on the other two aspects there is. You will see from this photograph that the area of anesthesia on the mesial surface has not changed a millimeter; it is exactly in the median line. In other words, there is never any overlapping of function between the right and left trigeminal nerves. Compare this line with the line on the inferior boundary. Here the line of demarcation has changed very materially. Immediately after the operation the anesthetic zone included part of the ear and followed the lower margin of the inferior maxilla. Five years later this line is in advance of the ear and several centimeters above the lower margin of the inferior maxilla. One can only explain this shifting of the anesthesia on the assumption that there is some overlapping of function on the part of the cervical nerves. Just why this is not manifest immediately after the operation is difficult to account for.

We have spoken of the sensory and motor function of the trigeminal nerve. We attribute also to it a trophic function. At least there are believed to be trophic centers in the ganglion that preside over the cornea. The trophic disturbances of the cornea, which sometimes follow operations upon the ganglion or even alcoholic injections of the ganglion, have been attributed to disturbances of the trophic supply.

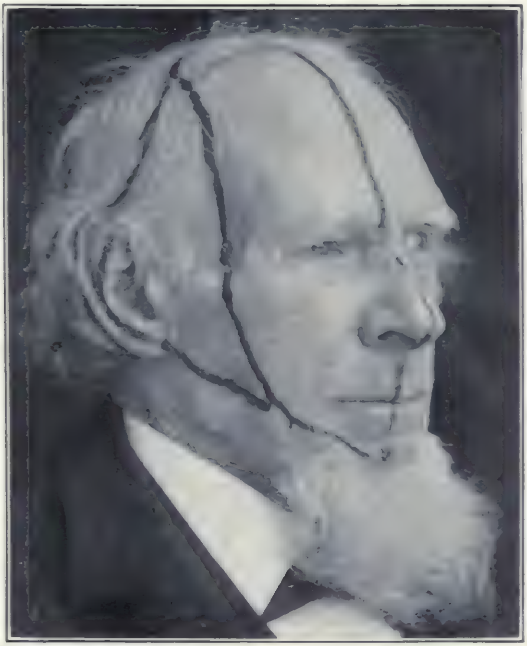


Fig. 29.—Two areas of anesthesia: the larger immediately after the sensory root operation; the other five years later.

Now there is but one indication for operation upon the trigeminal nerve—the relief of pain—but before we take up the question of treatment I want to discuss very briefly the various forms of trigeminal neuralgia, as their recognition has an important bearing upon the determination for or against surgical interference.

1. There is the neuralgia which, for a better term, I may

call toxic. In the majority of cases which I have seen the pain is in the supra-orbital division. Sometimes on one, sometimes on both sides. The pain may be intense, but it is constant, not paroxysmal, and of a boring character. The attack may last several days without intermission. This form of neuralgia is not relieved by surgical measures.

2. You are all familiar with the form of neuralgia associated with infection in the trigeminal distribution, as of the teeth and sinuses. In the majority of instances this pain subsides with the subsidence of the infection; in exceptional cases it may persist with such severity as to demand either an alcoholic injection or the avulsion of one of the peripheral trunks. But in this connection I want to impress upon you the fact that in but the rarest exceptions is dental infection or infection of the accessory sinuses a precursor of the major form of neuralgia, tic douloureux, for the relief of which the major operation is indicated.

And now I am going to refer to several forms of neuralgia in which the pain may be within the trigeminal field, but the origin is not primarily or wholly within the trigeminal system. I refer (1) to the neuralgias secondary to tumor invasion, (2) to neuralgia of the geniculate ganglion, and (3) to neuralgia of the sphenopalatine ganglion.

1. Time will not permit of a discussion in detail of the neuralgias that are directly the result of pressure or infiltration of tumors. In our clinical records you could find cases representing different groups classified according to the location of the tumor. You will see the record of a case in which there was a cerebellopontile tumor involving the sensory root of the ganglion. Before his admission to my clinic the patient had had numerous operations, including a gasserectomy, all without relief. You will see the record of an unusual case of endothelioma of the ganglion, in which the character of the pain closely simulated that of tic douloureux. There are other cases of middle fossa tumors not originating in the ganglion and these are more common. And finally you will see records of cases in which the tumors, usually carcinomata, have invaded the pterygoid fossa

and involved the several main divisions of the gasserian ganglion after their exit from the skull.

As you might expect when the seat of the lesion is peripheral to the ganglion, the pain is more or less constant, though intense, and lacks the shooting and paroxysmal character of the pain of tic douloureux. As these tumors are inoperable one refrains from advising the radical operation, and yet these patients make pitiable appeals for relief, and I find myself, in increasing numbers, giving alcoholic injections either of the second or third division or, if need be, of the ganglion itself, with intense satisfaction and with immeasurable gratitude on the part of the patient.

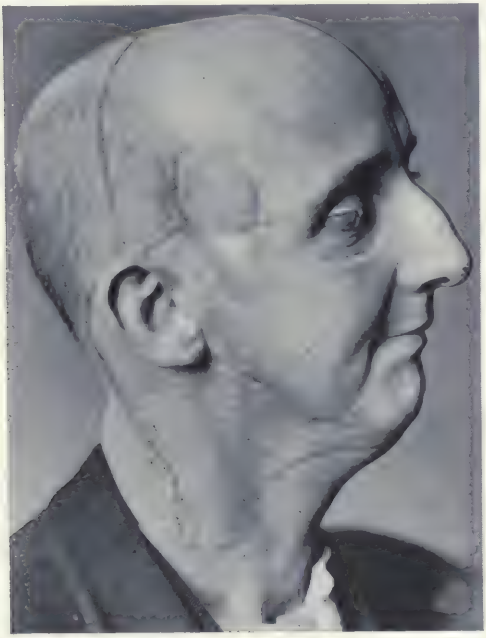


Fig. 30.—Case of tumor of cerebellopontile angle simulating trigeminal neuralgia. The patient had already had a radical operation on the ganglion before his admission to our service.

2. In 1907 J. Ramsay Hunt constructed a clinical picture in which the principal feature was an otalgia, although the pain

may overflow into the trigeminal territory and occasionally to the neck and shoulder. These attacks, which may be preceded by attacks of herpes, are attributed by Hunt to lesions of the geniculate ganglion, with its sensory supply from the sensory branch of the facial nerve. In upward of 500 cases of neuralgia that comprise our clinical experience there has been but one that might be assigned to this group.

3. There happens to be in the hospital now a lady, whom I have asked to come to my lecture today, as she presents the picture of a neuralgia that has been in recent years described by Sluder and attributed to lesions of the sphenopalatine ganglion. We will call it Sluder's neuralgia. The patient's pain is referred to the root of the nose, to the eye socket, in and about the ear, to the occiput, the shoulder, and arm. You will note that she winces when I make pressure over a point 5 mm. behind the mastoid process. This is a characteristic feature. In other cases pain may be referred to the frontal region, the tonsil, and pharnyx. To confirm the diagnosis I will apply a 5 per cent. solution of cocain immediately beneath the posterior tip of the middle turbinate, a point in close proximity to the sphenopalatine ganglion. The patient says her pain is entirely relieved and she feels as though a string had been cut and the tension and pain in the eye have entirely disappeared. This is the crucial test in the differential diagnosis and suggests a treatment which has been found more or less effective, namely, alcoholic injection in or about the ganglion. Because of the difficulty in accurately placing the injection it may have to be repeated several times.

We come now to the neuralgia, in which we as surgeons are especially interested. I sometimes speak of it as "surgical" neuralgia because it represents the type in the treatment of which surgical interference is an essential feature. But it is referred to in literature as "major" neuralgia, as "epileptiform" neuralgia, and as "tic douloureux." The most appropriate nomenclature is, I think, major trigeminal neuralgia, as the term differentiates it from the neuralgia of origin other than trigeminal and from the minor trigeminal neuralgias. This major trigeminal neuralgia has so many characteristic features that mistakes in diagnosis should be exceptional. Although seen occasionally in subjects under forty and exceptionally under thirty, it is a disease of middle life and of old people. Beginning primarily in the second or third division in 95 per cent. of cases, both of these divisions are eventually involved and sometimes the first division as well. The disease is characterized by attacks and the attacks in turn are featured by paroxysms of greater or less frequency. The attacks may last several weeks or months and are interrupted by intervals in which there is absolute cessation of pain. As years go by the attacks become more frequent, until finally there may be no interruption. Remember that this is a progressive disease, which so far as I know is not spontaneously arrested. The pain of the paroxysms is variously described as shooting, tearing, or burning; there is often the sensation of a red-hot iron thrust into the tissues. To say that the pain is intolerable expresses it mildly. There is probably no greater suffering in the category of human ailments. The pain is referred to the terminal distribution of the particular division involved, usually to the nose, upper lip, and teeth of the second division or the lower lip, teeth, and tongue of the third division. Associated with the pain phenomena are certain motor and vasomotor disturbances; spasm of the facial muscles, lacrimation, rhinorrhea, salivation, and flushing of the face. These are merely incidental.

Rich as has been our experience with major trigeminal neuralgia, our knowledge of its etiology is pitiably deficient. My knowledge of this phase of the subject can be expressed only in negations. The disease is not due to any peripheral infection such as dental sepsis or inflammation of the accessory sinuses. It does not seem to be due to a peripheral ascending neuritis or to a lesion of the ganglion itself. At least histologic examinations of specimens removed at operation have not exhibited any lesions that could account for the pain. To discuss further the etiology of this disease would lead us into the field of speculation and would not be profitable.

This patient upon whom we will operate today has had all his upper teeth extracted, but to no effect. This is a common experience. In fact, most of our patients have had the teeth either of the upper or lower jaw extracted, and most of the teeth are sound, but because the pain is referred to the teeth the patient or often the dentist thinks the teeth must be the source of pain. This patient has gone through the usual gamut, including teeth extraction, investigation of all the sinuses, osteopathic treatment, electric treatment, and endless drugs. His physician advised him to spend the winter in Florida in the vain hope that a warmer climate would spirit away the pain.

Only a few months ago I operated upon a Scotchman who had been sent from his home in Ayrshire, Scotland, to Southern California on a similar mission, but, as you will learn, without advantage to the patient. I speak of this patient's experience in detail in the first place because it is such a common one, and second, because it will serve to impress upon you at least what not to do in the interest of your patient and incidentally his pocket book, and the corallary of this statement is this: that there are but two justifiable methods of treating trigeminal neuralgia: alcoholic injections and section of the sensory root of the gasserian ganglion. If you should forget anything else in the lecture about this disease I hope in the interests of human suffering you will remember this statement. It seems almost incomprehensible and yet it is too often the case that these subjects are allowed to suffer for years, two, three, five, until perchance they find a physician or often, as it happens, a former patient, who tells them what they should have done.

While this patient is being anesthetized in preparation for the radical operation I will send for another, for whom I have planned an alcoholic injection. The question naturally arises in your mind why should the treatment in one case be alcoholic injection and in the latter the radical operation? The question is a very proper one, and I can answer it best by telling you how the decision is made. It is made usually by the patient himself. It has been my practice, when consulted by a patient with major trigeminal neuralgia, to tell him there are but two methods of treatment, the injection and the operation; that the former offers immediate but only transitory relief, about nine months; that the latter assures him permanent relief. Many questions will be asked as to the details of the injection and the operation, and after some deliberation the patient decides in favor of one or other, usually depending upon how long he has been a sufferer. For example, the patient I am going to operate upon today has been a sufferer for ten years; he has had an alcoholic injection in each of the last four years. After the first injection he was delighted with the result, at once resumed his business, and encouraged himself to believe that the pain would not recur. A year and a half later, while at his desk, he was seized with one of his old paroxysms; he endured it for a while, but after two weeks of it he turned up and asked for a second injection. The result of this, like the first, was gratifying to the patient. He ate his first square meal in two weeks and went back to business, again hoping he had seen the last of his pain. All went well for thirteen months, when he had a second recurrence, coming on, as the first, out of a perfectly clear sky, with no apparent reason,

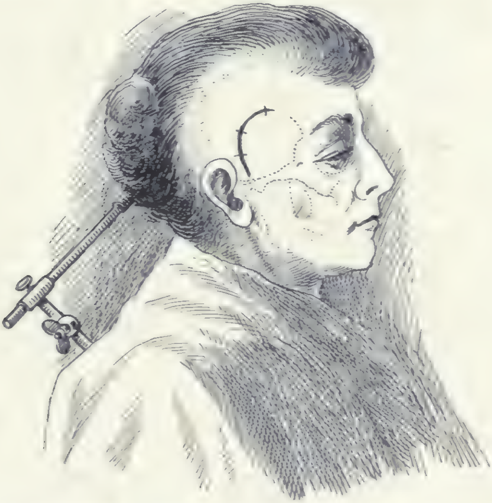


Fig. 31.—Sketch showing position of incision relative to the ear and zygoma, together with head attachment used on the special operating chair.

but the pain was more violent. A few days of it, and he rushed back to us for another injection, more or less demoralized and dejected. He dreaded the injections, and now he began to dread a recurrence. Though given absolute relief by the third injection, he was more or less apprehensive and uneasy, and now realized that the injections would not cure him. Returning to business, he wondered how long it would be before he would be seized with another attack. It was only nine months; the interval of relief was shorter after each injection; his morale was broken and he returned to us pleading for some permanent measure of relief, and as there is no contraindication, I have had him prepared for the major operation.

Now the experience of the second case is quite different, and it serves our purpose well for contrast. This patient has been a sufferer off and on for only eight months. The attacks, while severe, have not reached their maximum severity. He couldn't quite make up his mind to have a major operation and, as is my practice, I have allowed him to make his own choice, and he has chosen the alcohol injection. As the other patient is ready for operation I will conclude what I have to say about the injection until the operation is finished.

We are using ether as an anesthetic, skilfully given by a trained nurse anesthetizer, who knows every step of the operation and keeps the patient under such light anesthesia that a few minutes after the sensory root has been cut the patient will be conscious to answer questions. Note also the patient is in the sitting posture, a posture we have adopted for these reasons: because there is less bleeding, because the patient requires less ether, and because it is the most convenient posture for the operator, as the field of operation is exactly on a level with his eyes.[1]

Follow now the various steps of the operation: the winged incision, the cutaneous flap reflected forward, the musculo-aponeurotic backward. An opening in the skull is made 3 cm. in diameter, the center of the opening opposite the mid-point of the zygoma and the lower margin of the opening at the base of the skull. A larger opening is unnecessary, as the temporal lobe cannot be elevated more than 2 cm. above the floor of the skull. I am now making a punctured wound of the dura to allow the cerebrospinal fluid to escape throughout the operation. This is a very important step, as it enables the temporal lobe to be elevated with greater facility and less harmful pressure upon the brain. Now the dura is gradually separated from the inner aspect of the temporal bone both in front and behind our opening in the skull and along the base. Our first objective is the foramen spinosum through which the middle meningeal artery enters the skull. I can see the groove in the floor of the skull and will use this as a guide to the foramen. The oozing is readily controlled by these small pledgets of cotton. With this illuminated retractor the field of operation can be

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[1] For the various steps of the operation see Figs. 32–40.

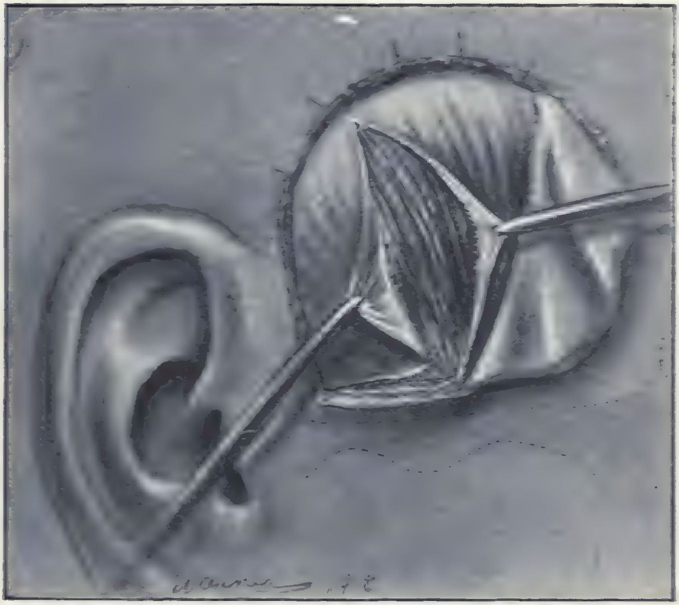

Fig. 32.—Technic of section of sensory root: Drawing showing approach to ganglion. Cutaneous flap reflected forward. Line of incision in temporal fascia and muscle is projected so that this musculo-aponeurotic flap may be reflected backward.

seen even from the benches. We have reached the foramen spinosum and the middle meningeal artery must be divided as it stands between us and the sensory root. To control bleeding I plug the foramen with cotton with this simple dental instrument before dividing the artery. Were there any bleeding from the peripheral stump I could control it readily with a muscle graft. In this case it is not necessary. The next objective is the foramen ovale; it is not $\frac{1}{2}$ cm. away. I can see it now a little in front and on the inner side of the foramen spinosum. Now comes the most important step of the operation, the recognition of the line of cleavage between the dura and the spinous sheath of the ganglion, the dura propria. Wearing as I do extra lenses of two diopters I can differentiate the anatomic details much more accurately than with the naked eye. The line of cleavage is sought at the foramen ovale just where the third or mandibular division is given off from the ganglion. With this blunt dissection I separate these two dural processes and gradually expose the superior surface of the posterior third of the ganglion and the sensory root as far as the opening in the tentorium cerebelli through which it finds its way from the posterior to the middle fossa. To expose the ganglion and the root a linear incision is being made in the dura propria, and I can see now the individual fasciculi of the sensory root. The operation is now all but completed. There remains only section of the root, but before doing that I search for the motor root, as we have found recently that it is not necessary to sacrifice it.

The conservation of the motor root is a matter of some moment. Until a year ago the motor root escaped only by accident and when cut there followed atrophy of the temporal, masseter, and pterygoid muscles. Atrophy of the temporal muscle implies a depression above the zygoma, which robbed the operation of what might be said to be an ideal cosmetic result. In fact, to avoid this, some surgeons were in the habit of resecting the zygoma. Atrophy of the pterygoid and masseter interferes somewhat with mastication, and the jaw when opened is deflected somewhat to one side. These seem to be matters of minor consideration, as compared with the primary object of the operation, the relief of such intense suffering. But by conserving the motor root the operation might be said to have reached a stage of perfection. I have raised the sensory root and can see the motor root coursing behind the root and disappearing beneath the ganglion. To be sure the motor root is not mistaken for a fasciculus of the sensory root I will stimulate what I recognize as the motor root with an electrode. You can see the temporal muscle on either side of our wound contracting. This is, of course, a convincing demonstration. Now for the final step. I elevate the sensory root on this small blunt hook and cut the root in two. It is not necessary to resect it, as it is an established fact in physiology that the nervous tissues, central to the ganglia, cannot regenerate. It is because of this that this operation is permanent in its effect, since if the root cannot regenerate there can be no recurrence of

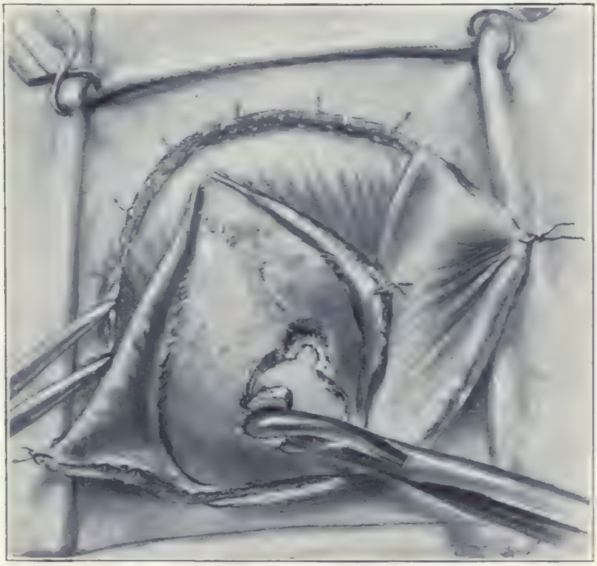

Fig. 33.—Technic of section of sensory root: Showing cutaneous flap reflected forward and musculo-aponeurotic flap backward and stitched to towels. Opening in skull being enlarged with rongeur forceps.

pain. The ether can now be discontinued, as the field of operation is entirely within the trigeminal territory, now a completely anesthetized zone. Before removing the retractor a survey of the field of operation may find one or more bleeding points readily controlled by tiny muscle grafts, clipped from the inner surface of the temporal muscle. The wound I close with interrupted silk sutures in four tiers. As bleeding is under control, no drainage is required. The patient, you see, is now recovering consciousness and I will test the conjunctival reflex on the affected side. It is absent. The eye will be irrigated with a boric solution and a special shield applied before the patient is returned to his room.

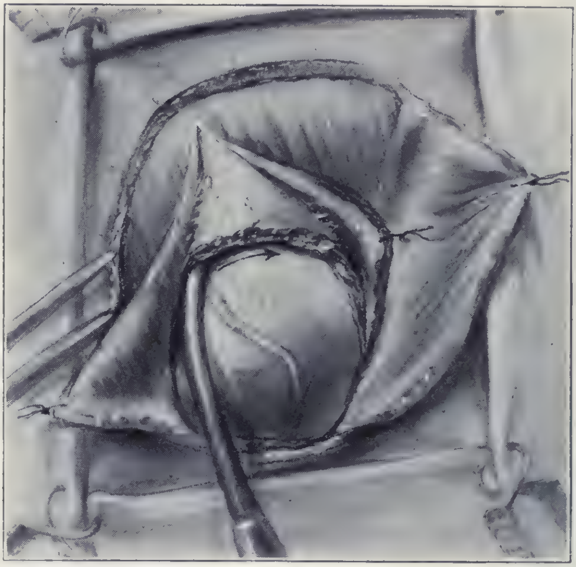

Fig. 34.—Technic of section of sensory root: Showing separation of dura from margins of bony opening.

You have witnessed what I have referred to throughout this lecture as the major operation for trigeminal neuralgia. By the major operation we imply section of the sensory root, an operation universally recognized as the operation of choice and one in which in Philadelphia we have a peculiar interest, in that it was first proposed by Spiller in 1901 as a substitution for excision of the gasserian ganglion, a procedure attended with greater difficulties, greater risks, and a much higher mortality. The risks of the sensory root operation have been reduced to a minimum, so small as to be almost negligible. In fact, in the last 175 operations in this clinic there has been but one fatality in the case of an elderly woman, who in the convalescent stage, that is, after she was up and about, succumbed to an apoplectic seizure. Despite the fact that the patients are for the most part elderly people, you will concede that a mortality of ½ of 1 per cent. more than compares favorably with the mortality of any other major operation which you have witnessed in your student days.

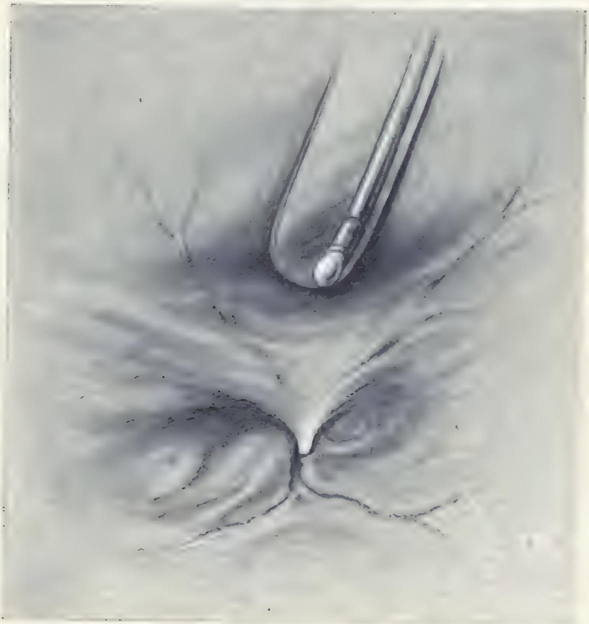

Fig. 35.—Technic of section of sensory root: Note the middle meningeal artery before its division and the outline of the foramen ovale a little in front and toward the median line. (Frazier, in Keen's "Surgery").

You may ask very properly what about complications and end-results? As to complications, there are but two: (1) Transitory facial paralysis of only occasional occurrence, the cause of which is a matter of speculation; but as the paralysis is only transitory it gives us no concern. (2) Trophic keratitis. This is a matter of more serious concern, but, fortunately, one which responds to appropriate treatment. As prophylactic remedies we use routinely boric acid irrigations, instillations of holocain and atropin, remedies in which I must confess having little faith. But should there be any exfoliation of the corneal epithelium the lids should be closed at once and kept closed by suture if necessary until the corneal defect is repaired. In upward of 300 major operations there have been but 2 cases in which it has been necessary to keep the lids closed. The patient should be informed before the operation that the anesthesia of the trigeminal zone will be permanent. In most instances the patient gladly accepts numbness as a substitute for pain, but

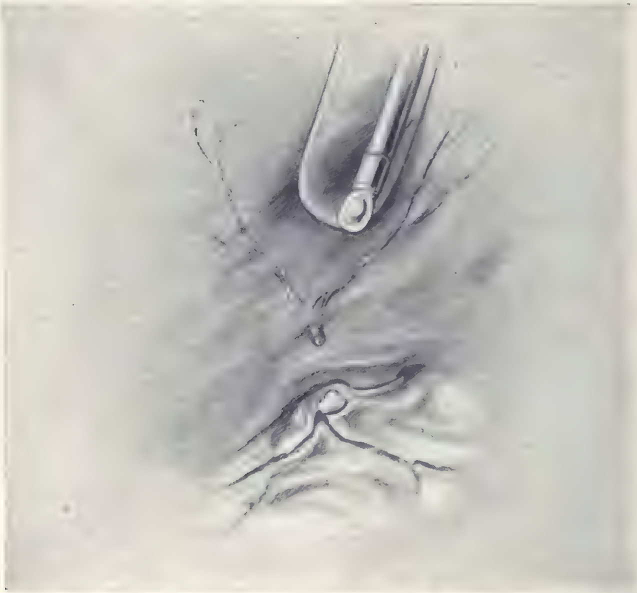

Fig. 36.—Technic of section of sensory root: The foramen spinosum is plugged with cotton and middle meningeal artery divided without ligation. (Frazier, in Keen's "Surgery.")

occasionally the patient may be more or less intolerant to this, and in a few instances the patient may complain of certain paresthesias, such as creeping and itchy sensations.

As to the permanent results, there can be no recurrence if the entire root has been divided. In only one instance have I had to operate a second time, and in that case I found one fasciculus had been overlooked. Let me warn you, however, of the unsatisfactory results that may follow the operation in cases of mistaken diagnosis; this statement applies particularly to hysteric subjects who may complain of as much pain after the operation as before. Once I reopened the wound within a week of the operation and, though the patient was conscious, clamping the gasserian ganglion with a hemostat elicited no pain whatsoever, a convincing demonstration that the sensory root had been entirely cut and all communication with the fifth root nucleus entirely severed. From every viewpoint this sensory root operation is the most satisfactory to the surgeon and most gratifying to the patient of any we are called on to perform.

Now let us return to the subject of alcoholic injections. A number of years ago when for one reason or another the major operation was not indicated, it was our practice to remove by avulsion one or the other of the peripheral branches, usually the supra-orbital, the infra-orbital, or the inferior dental nerve. Recurrence usually within the year was the rule. With the exception of that on the supra-orbital nerve, the others have been entirely abandoned in favor of deep alcoholic injections for various reasons. In the first place with the alcoholic injections we reach the main division, that is, the maxillary and mandibular, and thereby control pain in all their branches; in the second place, there is not the formality of an operation, with all that it implies, a general anesthetic and a wound, the scar of which will be more or less conspicuous; and in the third place, the effect of the alcoholic injection may be more lasting.

As to the indications, I have already told you that in major trigeminal neuralgia I perfer that the patient decide whether he will have the major operation or the injection. There are occasions, however, when there is a reasonable doubt as to the diagnosis, and under these circumstances it is a very good plan to give an alcoholic injection. If the patient has the trigeminal neuralgia of the kind that will be relieved by the operation, he will enjoy immediate relief after a successful injection and will at the same time experience the numbness that he must expect as a permanent affair after the major operation. If the case is not one of the type appropriate for the major attack the patient will not be relieved of pain at all, he may complain of pain in another region or of a different kind of pain, or, as is not unusual, may complain more bitterly of pain after the injection than he did before. This should be interpreted as a warning by the surgeon and as an absolute contraindication to any operative undertaking. But there are minor forms of neuralgia which do not respond to other remedies when the pain is intense enough to warrant an alcoholic injection.

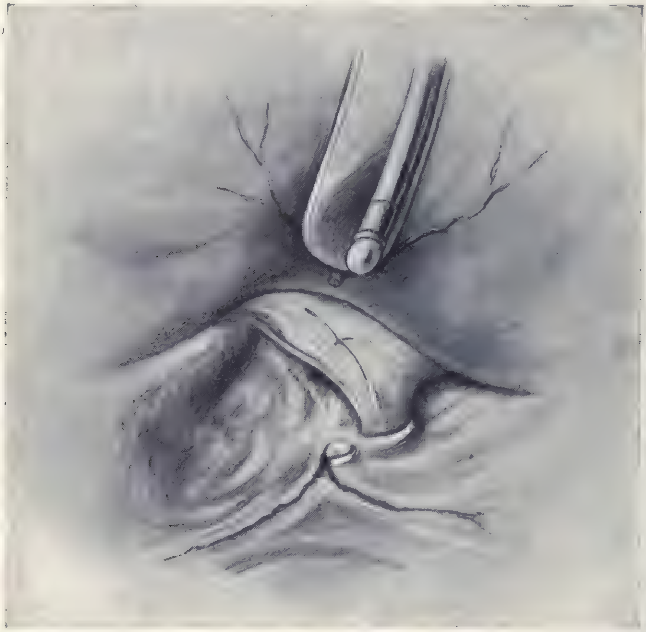

Fig. 37.—Technic of section of sensory root: The foramen ovale mandibular division, posterior third of ganglion and sensory root in field. The incision in the dura propria. (Frazier, in Keen's "Surgery.")

Before proceeding to inject the patient I have previously shown you, let me make a few general remarks as to the technic of injections. Because the knife is not used do not fancy for a moment that the undertaking is one you can venture upon without due preparation. By preparation I mean practice upon the cadaver and a study of the anatomy that will enable you to visualize the structures which the needle must penetrate and the important anatomic structures in close proximity. Because of anatomic variations I consider it still, abundant as my experience has been, an exceedingly difficult undertaking, and if given the choice would elect the major operation. As a matter of fact, at the first attempt at injection, at the first sitting, you must be prepared for failure. In fact, when a patient comes to the clinic from out of town I insist upon his planning to remain in the hospital at least a week, as the injection if not at first

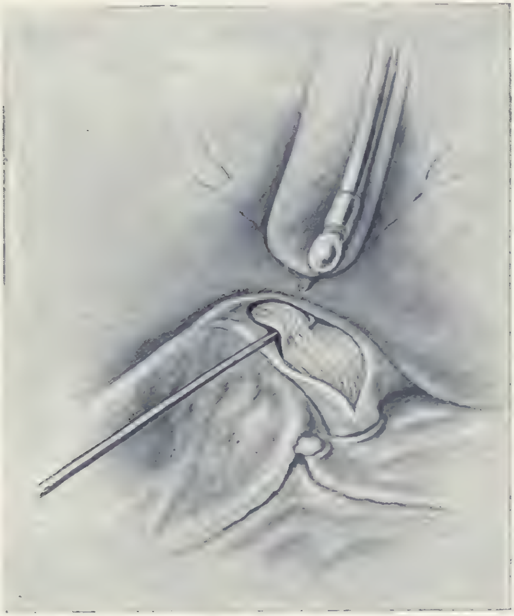

Fig. 38.—Technic of section of sensory root: The sensory root is elevated with hook and beneath it one looks for the motor root. The motor root should be identified before the sensory root is cut. (Frazier, in Keen's "Surgery.")

successful must be repeated. By successful injection I mean one in which $\frac{1}{2}$ to 1 c.c. of the solution (I use 95 per cent. or absolute alcohol) actually penetrates the nerve sheath and is diffused within the nerve fasciculi. If an insufficient amount is injected the effect may be only transitory, the pain may be immediately relieved, and there may be a transitory anesthesia in the terminal distribution of the nerve, but in forty-eight hours the pain will return. Usually one can tell whether the injection has been successful in two ways: if the needle is actually within the substance of the nerve considerable force will be required to empty the syringe, and after the injection a test with the needle will elicit total anesthesia in the zone supplied by the nerve injected. It is assumed, of course, that pain is instantly and absolutely relieved.

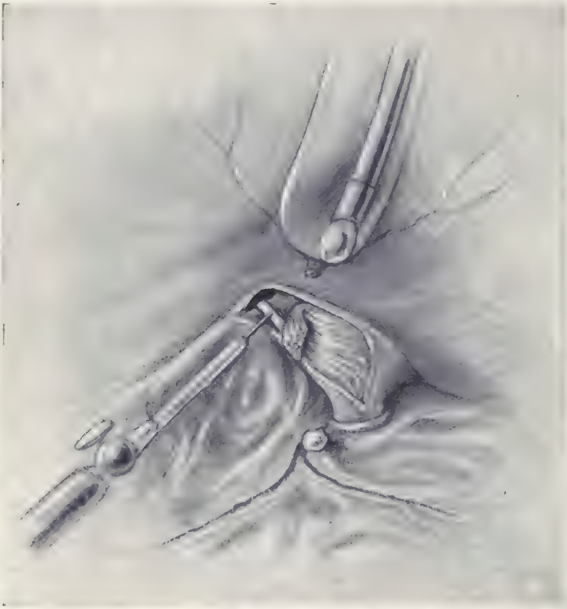

Fig. 39.—Technic of section of sensory root: The sensory root has been divided and reflected over the ganglion, exposing the motor root, to which the electrode is being applied. (Frazier, in Keen's "Surgery.")

If not forewarned the inexperienced may be somewhat chagrined by some unpleasant consequences. Puncture of the middle menigeal or the branches of the internal maxillary artery will be followed by extravasation of blood. Trauma of the pterygoid muscles or the injection of alcohol into the muscles in ineffectual attempts will be attended with stiffness of the jaw. If the eustachian tube has been penetrated by the needle the patient may complain of deafness or vertigo, and occasionally the needle or the alcohol may damage the third or sixth cranial nerves and determine an oculomotor or abducens palsy. These, however, are only transitory.

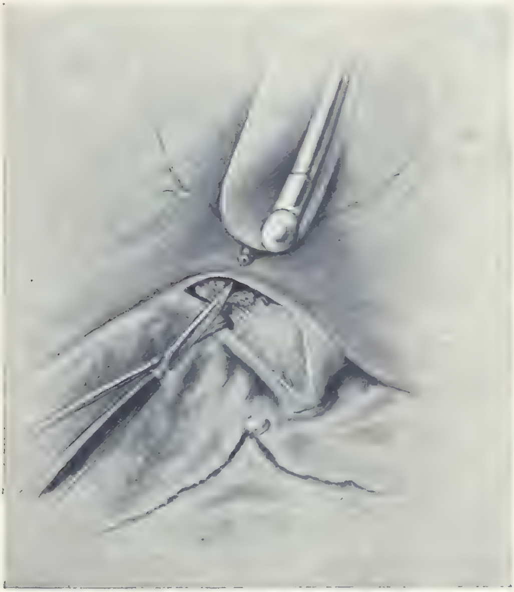

Fig. 40.—Technic of section of sensory root: The dura propria reflected. Sensory root elevated on hook and root sectioned with sharp bistoury. (Frazier, in Keen's "Surgery.")

The patient is now ready for an injection of the second and third divisions. In this clinic our practice differs from that of others in that the injection is given under nitrous-oxid anesthesia. There is no reason in experienced hands why a general anesthetic should not be used and the patient spared the most intense and acute suffering. If performed in the conscious state the ordeal is so distressing that in the event of the inevitable recurrence the patient so dreads the thought of a second injection, that he will put it off as long as he can endure the pain. Our technic differs in another particular in that we use this special device, we have styled a zygometor, on which we can see by the graduated scale the point at which the needle should penetrate the skin. The patient is now under the anesthetic. I disinfect the skin with alcohol, and to reach the mandibular division I enter the needle at the 2.5 cm. mark, thrust the needle directly inward and slightly upward. The needle has penetrated the tissues to a depth of 4 cm. and feels as though it had met with greater resistance. To see whether the needle is

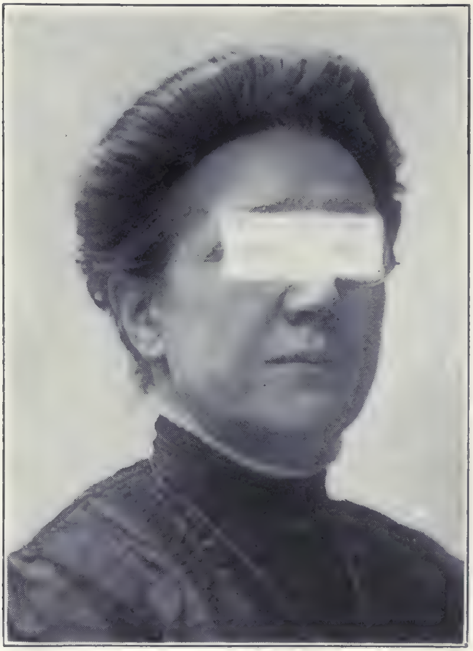

Fig. 41.—Cosmetic results in patient after operation. The incision is entirely within the hair line, hidden from view.

in the substance of the nerve, the syringe charged with 1.5 cm. of 95 per cent. alcohol is attached to the needle and to advance the plunger I must use a great deal of force. This assures me that the alcohol is being diffused in and not about the nerve. Had I failed in the first attempt I would not have withdrawn the first needle, but made the attempt with a second needle, varying the direction first a little forward of the first needle and, failing in this, a little backward. For the second division the needle enters the skin at the 3.5 cm. point on our scale and is directed upward and forward in the direction of the spheno-maxillary fissure. This is a more difficult injection because the nerve trunk is smaller and it is not so easy to visualize the proper direction, and in the knowledge that in 20 per cent. of cases the nerve cannot be reached there is this element of uncertainty in the mind of the operator, when he fails at the first or second attempt. The needle has penetrated a distance of 5 cm., and as I advance the plunger the alcohol escapes so readily that I am sure the point of the needle is not in the nerve trunk. I take a second needle and direct it a little more upward and you see the patient is moving. Though unconscious of pain patients

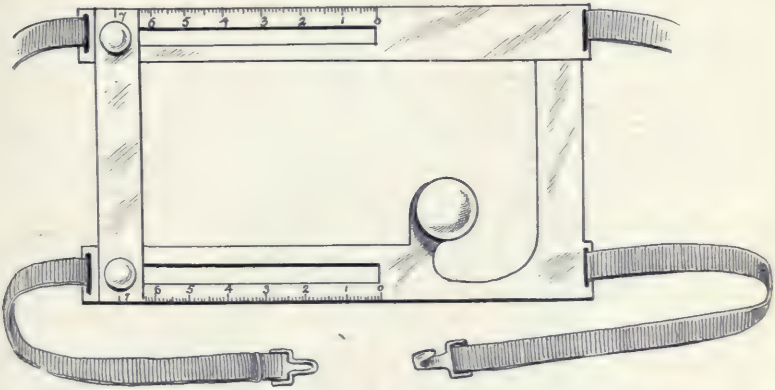

Fig. 42.—The zygometer, used in alcoholic injections. The fixed point is the external auditory meatus in which the button fits. One measures along the scale for points at which the needle is to be introduced, instead of measuring from bony prominences which are difficult to locate.

are subconsciously disturbed when the needle impinges on the nerve or when the alcohol is injected. In the second attempt the alcohol has evidently reached its proper destination; we let the patient come out from the effect of the anesthetic and test for anesthesia. Thrusting a needle in the upper and lower lips, gums, tongue, and hard palate you see causes no pain whatsoever and the patient says his cheek and tongue feel swollen. This is a very telling test of a successful injection and a bit of information usually volunteered by the patient.

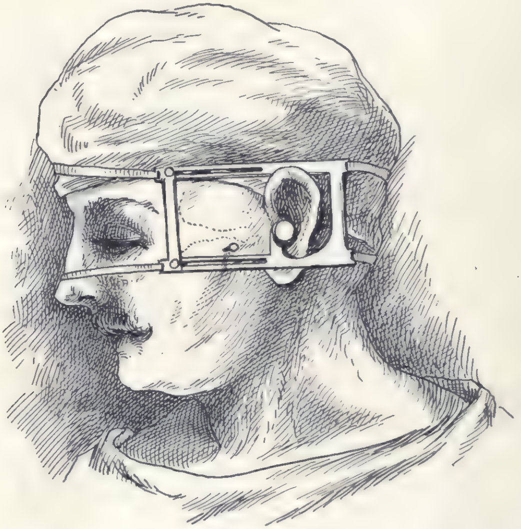

Fig. 43.—Rough sketch showing the zygometer in place. (See Fig. 42.)

I have but one more demonstration to make in conclusion, an injection of the gasserian ganglion in a patient, under treatment by Dr. Pancoast in the *x*-ray department, for extensive carcinoma of the face. I have already told you how I felt toward patients with these often hopeless lesions. The tendency on the part of the surgeons to "scrap" these miserable subjects is too well known; they deserve more consideration. We use Härtel's technic with slight modifications, and, as before, inject under nitrous-oxid anesthesia. Note that I have drawn two lines on the face from the point at which the needle is introduced 2 cm. from the angle of the mouth; one of these extends in the direction of the pupil, the other toward the articular eminence of the zygoma. These lines represent the two planes in which the needle must be directed: that the needle must not be directed more mesialward than the pupillary line and not on a lower plane than the line to the articular eminence. Of these two, the latter is the more important, as the needle could readily penetrate the jugular foramen and vein if this restriction was not observed. As with injections of the second and third divisions, injection of the ganglion should not be undertaken without due preparation. There is much that comes from practice and experience that cannot be conveyed in the printed dictum. I advance the needle in the prescribed plane and at 6 cm. I can feel the needle entering the mandibular division. At this point, where the nerve is making its exit through the foramen ovale, I will begin to inject the alcohol, and slowly advance the needle a distance of 2 cm. into the ganglion. Stopping at intervals of 0.5 cm., and at each interruption rotating the needle so that the eye of the needle faces various directions. This ensures a more widespread diffusion of the alcohol throughout the ganglionic tissue.

The subject of ganglionic injections must not be left without a warning as to the incidence of keratitis. In Härtel's original series keratitis developed in 25 per cent. of his cases. This is a serious matter and is sufficient to condemn this method in the treatment of major trigeminal neuralgia. There are those who would have us adopt alcoholic injections as a substitute for the radical operation, but the incidence of keratitis is prohibitive. Furthermore, while the alcoholic injections of the ganglion give longer periods of relief than injections peripheral to the ganglion, the effect is by no means uniformly permanent, so that this treatment cannot be regarded as a radical cure, and therefore not in any sense as a substitute for section of the sensory root. But in dealing with the pain from these advanced cases of carcinoma one hesitates to urge the major operation, and feels justified, in view of the otherwise hopeless condition of many of these patients, of incurring the risk of corneal complications. At least this has been our policy.

Let me now briefly summarize the ground I have covered:

We have given a classification of various types of neuralgia so that you may be able to distinguish those which may be relieved by operation upon the trigeminal nerve and those which may not. Briefly referring to the pathogenesis of major trigeminal neuralgia, we dwelt upon the choice of method in its treatment, whether by alcoholic injections or by operation. You witnessed the major operation—section of the sensory root of the gasserian ganglion—and were told the immediate and end-results. Finally, the difficulties and complications of alcoholic injection were dwelt upon, and the technic of injecting the second and third divisions and the ganglion itself was demonstrated.

CLINIC OF DR. ASTLEY P. C. ASHHURST

EPISCOPAL HOSPITAL

BIRTH INJURY OF THE RIGHT SHOULDER, NEUROLYSIS OF THE BRACHIAL PLEXUS

THE first patient for operation this morning is a girl who is now ten years old. She came under my care in September, 1913, when she was three years of age. There were two other children; the first (at that time seven years old) had had the left shoulder "broken in birth." The second child, then six years old, had "the nerve hurt" in birth (right shoulder), "but it came all right about six weeks after birth." A fourth child born after I first saw the present patient was killed during delivery. There was evidently need in this family for some advance in obstetrics. The two older girls whom I examined subsequently both presented the typical picture of birth injuries of the shoulder, but in such mild degree that very little disability remained, and no treatment was indicated. This patient, Catherine, was born head first and no instruments were used; she seemed at birth to have no sensation in the left arm, and it had always been utterly useless. She chewed the fingers until they bled and burned the hand several times without evincing any sensations of pain. As you will see, the finger-nails still show marked lack of development, an indication of interference with their nutrition (Fig. 44). There was, when I saw the child first, complete flaccid paralysis of the left upper extremity. I thought at the time the lesion was a tearing out of the roots of the brachial plexus from the spinal cord. She had already been seen by nerve specialists and orthopedic surgeons, who told the mother nothing could be done. Owing to the complete absence of sensation, which had persisted for over three years, this seemed reasonable advice, and it was repeated. Nine months after my first examination of this child I sent for her again, especially as it had not been noted at the first examination whether or not there was a posterior dislocation of the shoulder. You will recall that birth injuries of the shoulder such as this child presents have been, from the time of Duchenne (1872) and Erb (1874), considered as due to nerve lesions occurring in the brachial plexus and most frequently involving the fifth and the sixth cervical roots. Although Küstner in 1889 stated that all such cases seen by him really were instances of separation of the upper epiphysis of the humerus, and although Whitman in 1905 called particular attention to posterior dislocations of the shoulder often associated with this condition, it was not until T. Turner Thomas, that chronic disturber of the peace, turned his attention to these cases and proposed (1910) the theory to which he still adheres that the supposed paralyses are secondary to a primary lesion of the capsule of the shoulder-joint; it was not, I say, until T. T. Thomas began his studies of this subject that it took on a new interest for surgeons. His theory is that the effused blood, lymph, and synovial fluid catch the nerves in

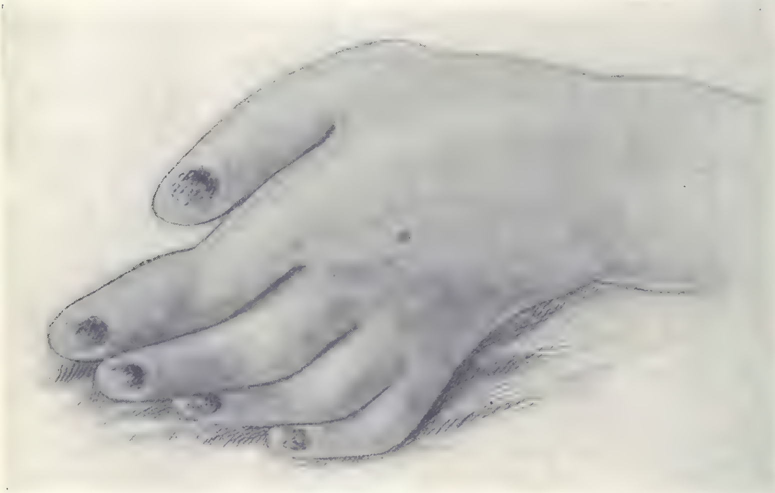

Fig. 44.—Trophic changes in the nails in a case of laceration of the brachial plexus (birth injury).

cicatrical tissue and that the dislocation so frequently accompanying these birth injuries is primary, and therefore the cause, not the result, of the brachial palsy. Similar teachings were subsequently (in June, 1912) promulgated by Lange, but neither Lange nor Thomas has been able to secure general recognition of the truth of this doctrine.

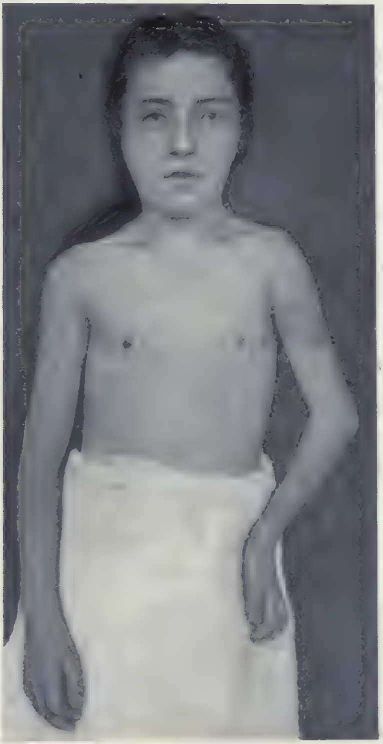

Fig. 45.—Paralysis from laceration of brachial plexus (birth injury).

From the observations which I have made myself in this class of cases, a number of which I reported in 1917 (Annals of Surgery, 1918, I, 25), it seems to me that, while the majority of birth injuries of the shoulder have a peripheral lesion of the nerves immediately surrounding the shoulder-joint, probably due, as Thomas says, to an original trauma to the joint proper, yet there certainly are cases where the lesion is in the roots of the brachial plexus, and, as I have stated before, the patient I am about to operate on, in my opinion, belongs to this class. When I saw her for the second time in June, 1914, when she was past four years old, I learned that the child had not burned her fingers since Christmas and that after the first of the year she had begun to move her fingers. She could then (that is, in June, 1914) flex the shoulder slightly, the axillary fold muscles had fair power, there was some power in the biceps, and she could extend the wrist well. There was a subspinous dislocation of the humerus. Operation was recommended at that time to secure reduction of the dislocation, since it had been determined by an experience with reduction of a number of similar dislocations that a considerable degree of improvement might be expected in apparently paralyzed muscles if deformities were overcome and the weak muscles were allowed to work at better advantage.

Accordingly, in December, 1914, reduction of the dislocation of the shoulder was accomplished by open incision, but although the dislocation stayed reduced it was noted a year after the operation that there was very little improvement in the power of motion and no more has been regained since (Fig. 45).

Now the operation today will consist in exposing the brachial plexus and determining if possible what lesions exist. As the paralysis is confined to the hand and forearm (Dejerine-Klumpke type) it is evident that the disabling lesions are in the lower roots of the brachial plexus (seventh and eighth cervical and first dorsal—Plate II). It is not likely, I believe, that much good can be accomplished, but it is justifiable to make the exploration. The patient being etherized and the neck extended over a sand-bag, I make an incision about 8 cm. long, above and parallel to the left clavicle. The omohyoid muscle is found and divided, also the suprascapular and transversalis colli arteries and veins are doubly ligated and divided. Next the lateral margin of the anterior scalene muscle is identified and you will see here the phrenic nerve overlying it. By following the phrenic nerve upward to its origin in the fourth root of the

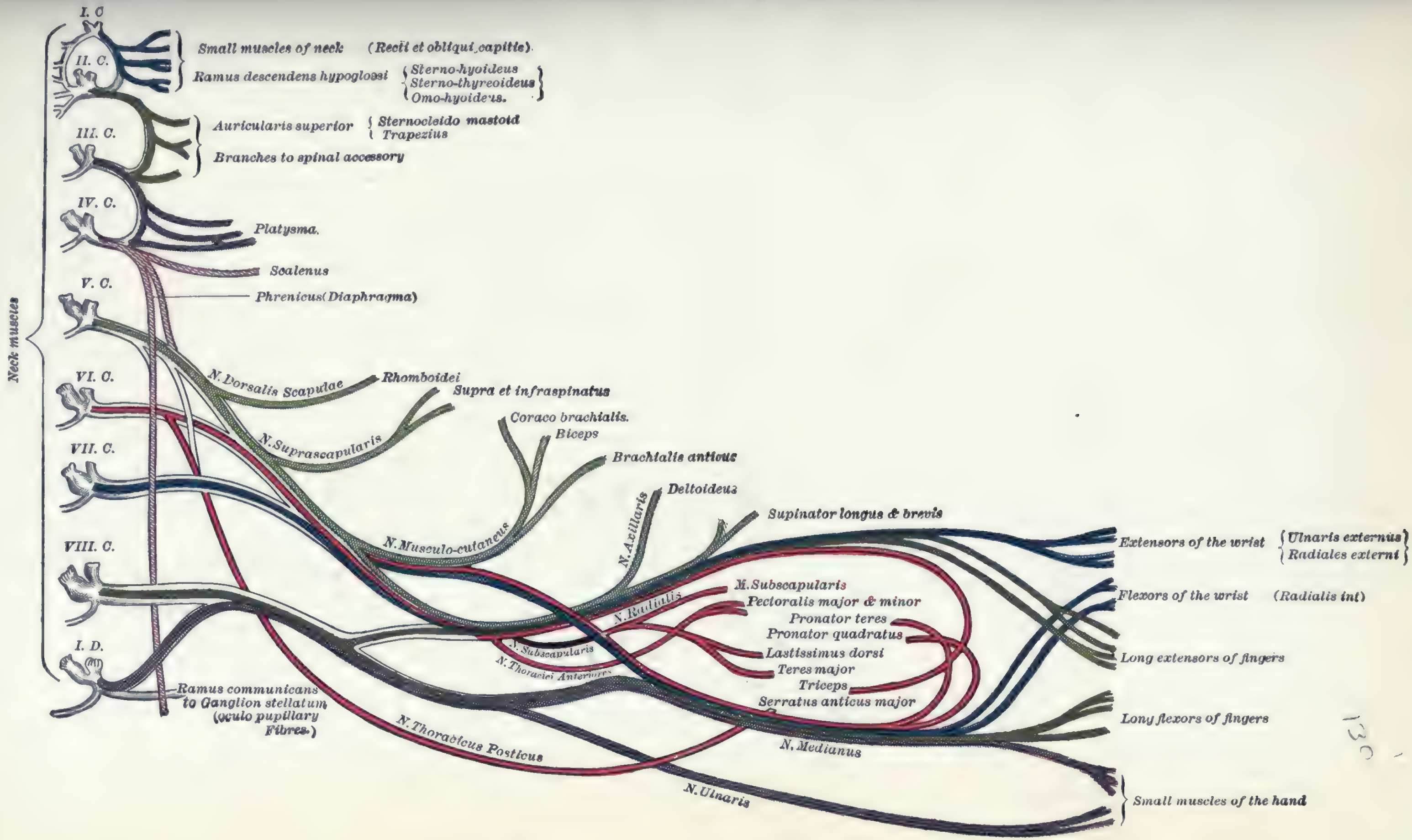

Diagram of the cervical nerves. (After Kocher.)

cervical plexus it is easy to identify the fifth and the sixth cervical roots, emerging between the anterior and middle scalene muscles (Fig. 46). There is much scar tissue involving their junction with the seventh. This is dissected free. By turning this mass of scar tissue laterally I can expose here deeper in the neck dense scar tissue involving the roots of the seventh and eighth (Fig. 47). Here you see, also, is the subclavian artery. I have accidently wounded the pleura as a little whiff of air enters the wound. No symptoms are produced and the pleura will heal without difficulty. Temporarily a gauze sponge is placed over

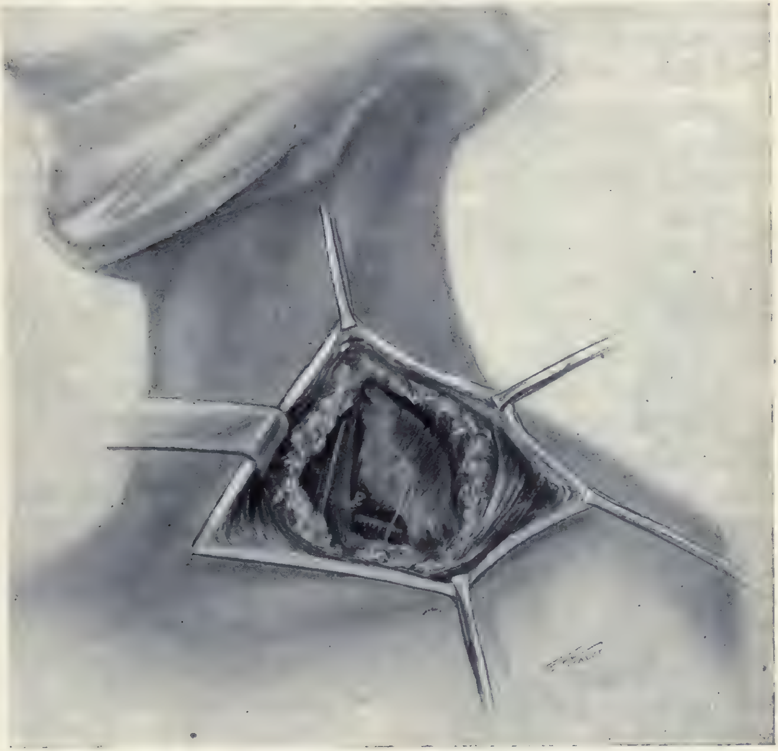

Fig. 46.—Brachial plexus exposed, showing scar tissue involving fifth and sixth cervical roots. Note subclavian artery, phrenic nerve (on anterior scalene muscle), suprascapular artery ligated and cut, and small nerve descending to supply subclavius muscle.

the puncture. It is impossible to find the first thoracic root which should lie just posterior to the subclavian artery, and I presume it has been torn off within the vertebral canal (Fig. 48). Having cleared up the scar tissues as far as possible, and in so doing having intentionally divided the nerve to the subclavius muscle, which is of very little significance, I will stimulate the nerves with the faradic current in an effort to determine whether any motion is transmitted to the hand. These nerves, the fifth and sixth, in spite of the scar tissue, transmit the faradic impulse very well, but cause no motion below the elbow. Faradic stimulation of the seventh and the eighth roots is also transmitted chiefly to muscles above the elbow, but at times we think there is slight extension of the fingers, but this is doubtful. The nerve-fibers which supply the small muscles of the hand and the flexors and extensors of the wrist should pass through the seventh and the eighth cervical and first thoracic (Plate II).

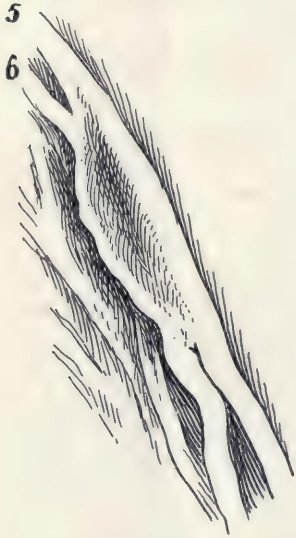

Fig. 47.—Scar tissue involving fifth and sixth cervical roots dissected free and turned laterally.

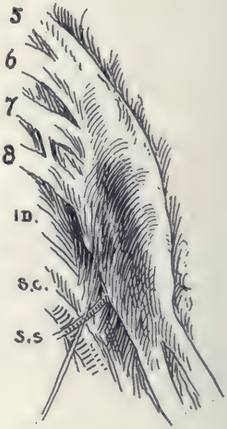

Fig. 48.—Completed dissection of roots of brachial plexus. Note partial rupture of eighth cervical and absence of first dorsal root.

Of course, if these nerve-fibers have been cut off from their central connection since birth it is not likely that faradic stimulation of their peripheral ends, even below the scar tissue in the plexus and as far down as I can reach under the clavicle—it is not likely, I say, that such stimulation will be transmitted to the paralyzed muscles. I do not think there is any more I can do at this time. I will take a pedunculated flap of fat from the region of the trapezius and pass it beneath the roots of the fifth and the sixth and over those of the seventh and eighth in order to prevent, if possible, the re-formation of such dense scar tissue (Fig 49). The platysma is now closed with interrupted chromic catgut and the skin with a continuous suture of the same material.

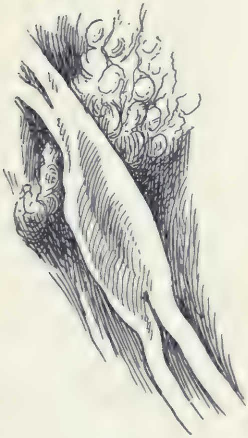

Fig. 49.—Flap of fat drawn beneath roots of fifth and sixth cervical and over those of seventh and eighth roots.

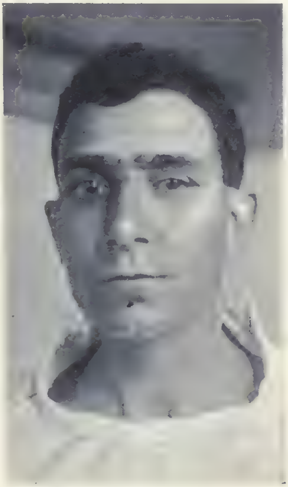

Fig. 50.—Enophthalmos from involvement of sympathetic nerve in laceration of roots of left brachial plexus.

I have operated on two adults with similar lesions, and in neither of them have I been able to do any more than in this child. In one of them it was evident that the fibers connecting the first dorsal root with the sympathetic nerve were involved, as there was slight enophthalmos and contraction of the pupil (myosis) on the same side (Fig. 50). If anything can be done for this child in the future it will probably consist of the transplantation of nerves below the clavicle, transplanting one or more of the active nerves which supply relatively unimportant muscles into the nerves, the median and the ulnar (especially the median), which supply the small muscles of the hand. Her upper extremity certainly will be more useful with the hand active and the shoulder paralyzed than as it is now with the shoulder active and the hand paralyzed.

(The first dressing on this patient was made a week after operation. The wound was healed and she was allowed to go home, returning to the dispensary for treatment with massage and electricity.)

FRACTURE OF THE TIBIA: OPEN REDUCTION

The second case this morning is an irreducible fracture of the left tibia and fibula above the ankle-joint (Fig. 51). The child, who is eleven years old, was admitted to the hospital on October 26th, having fallen into an excavation being made for a moving picture theater. She says she fell about 10 feet in height. On admission a few hours after the injury it was found that there was marked swelling over the lower half of the left leg, with ecchymosis and blebs on the inner side. There was crepitus and preternatural mobility. The leg was put in a fracture-box in the receiving ward and the patient was sent to the Children's Ward.

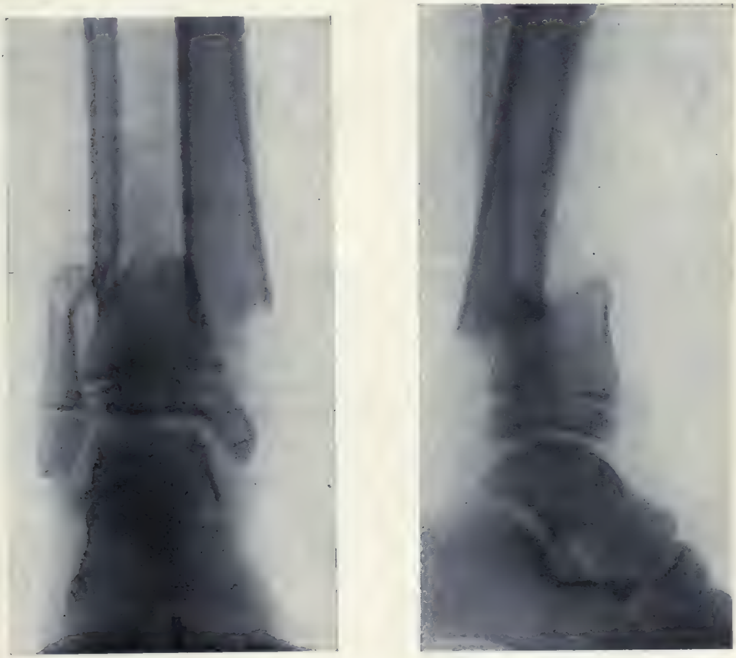

Fig. 51.—Irreducible fracture of tibia and fibula.

On November 1st I took over the service from Dr. H. C. Deaver, under whose care the child had been up to that time. Two different attempts had been made on Dr. Deaver's service to secure reduction of the fracture, which, as the x-ray showed, was in a very bad position (Fig. 51). When I saw her it was evident that open reduction would have to be done, but in order to do this it was necessary to have the soft parts in reasonably good condition, and as we planned to do the operation about ten days after the injury we began the preparation two days before the time set, first washing the leg as if for an operation, puncturing the large blebs over the internal malleolus with a

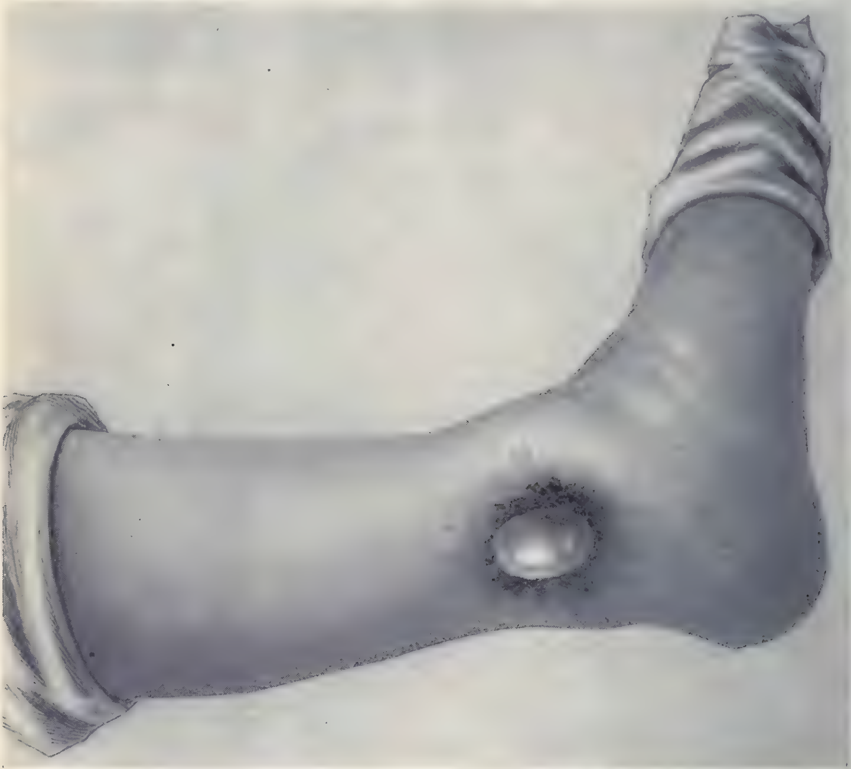

Fig. 52.—Fracture of tibia and fibula above ankle showing large bulla with surrounding ecchymosis, present on admission. (See also Figs. 51 and 53.)

scalpel (Fig. 52), and applying a soap poultice to the entire limb from the knee to the end of the toes. Whenever the skin is very dirty and you wish to soften up the superficial layers of the epithelium and mechanically cleanse the leg there is nothing quite as satisfactory to use as a soap poultice. This is made by melting half a cake of Ivory soap in just enough water to dissolve it; this is heated on a water-bath, and when solution is complete, a teaspoonful of sugar, and one tablespoonful each of ether and of alcohol is added; the resulting poultice should be of the consistence of soft ointment.

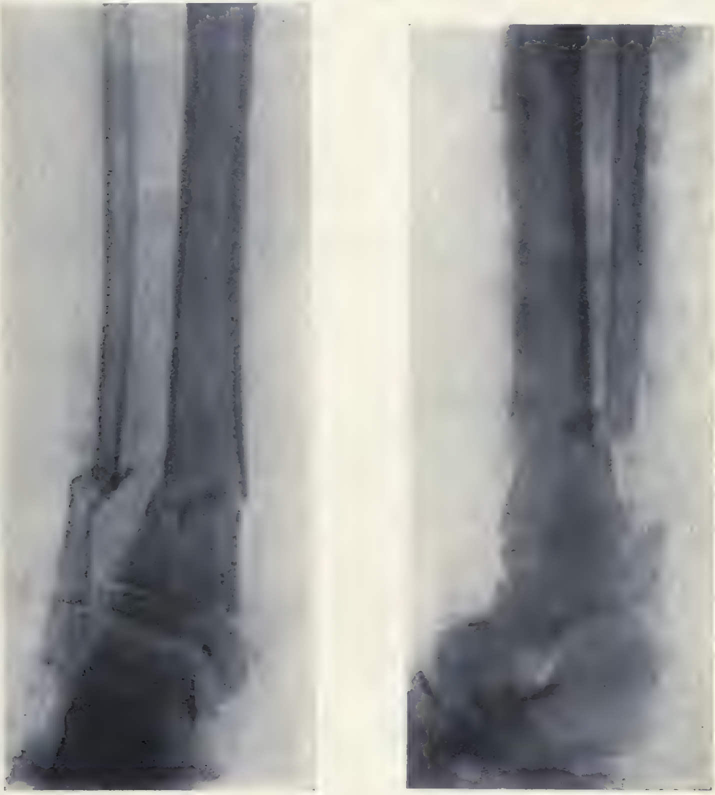

Fig. 53.—Skiagraphs after open reduction of fracture shown in Fig. 51.

After washing and shaving the part in the usual way, this poultice is applied thickly covered with sterile gauze, and left in place for twenty-four hours at least. This should be done at least two days before the time set for operaion. A bleb such as this girl had should be treated, even before the soap poultice is applied, by puncturing, allowing the epiderm to fall back on the skin beneath and covering the surface with sterile powder. When the skin has been dry for twenty-four to forty-eight hours then it is safe to begin the preparation for operation with the soap poultice.

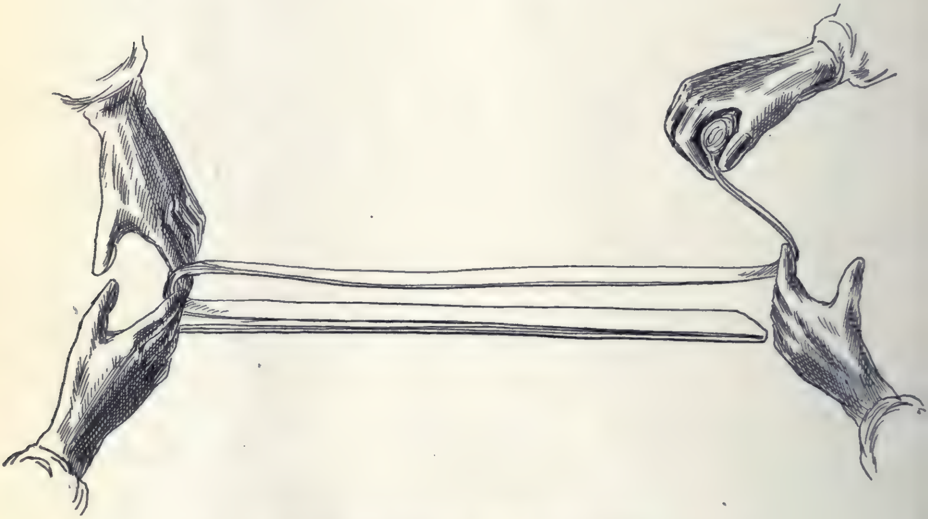

Fig. 54.—Method of making splints from plaster of Paris.

The day before the operation the leg is again washed with soap, rubbed with alcohol and with bichlorid, and tied up in dry sterile gauze or (for economy's sake) in a dry sterile towel. We always prepare a very much larger area than we intend to expose at operation. In this child, for instance, with fracture of the lower third of the tibia, the leg has been sterilized from above the knee to beyond the ends of the toes. And in all operations on bones and joints I have the part formally prepared twice, on two separate days.

Through a curved incision over the anterior surface of the tibia and convex laterally the tibia is exposed and the periosteum divided with another scalpel. The wound margins are excluded with sterile towels and the fracture reduced by grasping the end of the upper fragment with a Lambotte forceps and manipulating the lower fragment into place by means of the foot. No fingers are put into the wound. Nothing is done to the fibula. Almost invariably the fibula will take care of itself in fractures of the shafts of the leg bones. As the fracture shows little tendency to become displaced it will not be necessary to fix it by plate or other means. The deep fascia and the skin are closed separately; and after a sterile dressing is applied plaster-of-Paris splints freshly made are used for fixation. The splints are easily made by folding the bandage back and forth

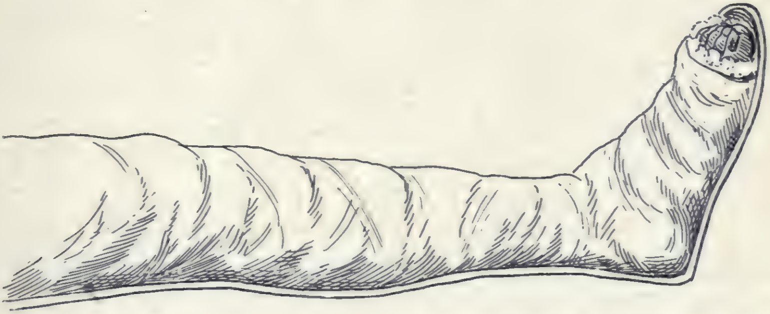
Fig. 55.—The first plaster-of-Paris splint is applied posteriorly, and bandaged in place.

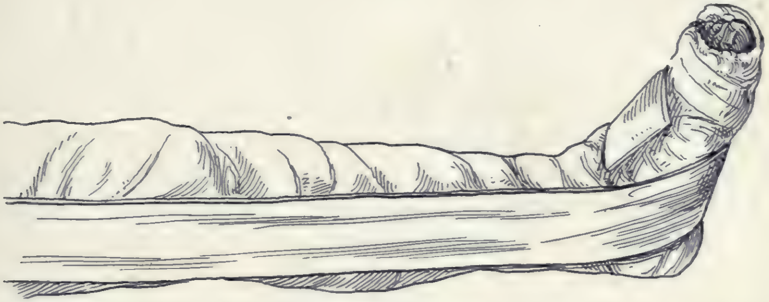
Fig. 56.—The other plaster-of-Paris splints are applied around the foot and along the sides of the leg.

until a sufficient thickness is secured (Fig. 54). Two bandages will be enough for each splint in a leg of this size. The first plaster splint, still soft and wet, is adjusted posteriorly over the popliteal space, down the leg under the heel and up the sole of the foot to beyond the toes (Fig. 55). It is then bandaged securely to the leg with flannel bandages while a second splint is being made. The second splint starts on the dorsum of the foot over the first metatarsal bone, passes outward over the dorsum of the foot, around the sole, and up the median side of the leg to the knee. It likewise is bandaged with flannel bandages. The third splint starts on the dorsum of the foot in the region of the fourth metatarsal, passes inward over the dorsum of the foot, across the sole, and up the outer side of the leg to the knee. It also is covered with a flannel bandage. While they set I will continue to hold the leg in what I believe is the correct position, but we will have further *x*-rays made after the setting is complete and ascertain what position the bones are in at that time (Fig. 53).

These splints, originally introduced, I believe, by Dr. Stimson, of New York City, are a great convenience in that being made to order and fitted accurately they are efficient. As soon as the setting is complete the patient can leave his bed, go around the ward in a wheel chair, and consider himself convalescent.

By inserting a layer of flannel bandage between each splint as it is applied each splint can be removed separately in order to dress the leg, for it is important not to leave a leg or arm, or any fractured part, done up immobile in plaster of Paris indefinitely. In certain fractures it may be necessary. In those of the hip, for instance, it is better after the fracture is reduced and a plaster cast applied in abduction to leave it on until union is secured than to attempt to take it off too soon for the sake of securing mobility in the knee or the hip. But, as a rule, in fractures such as those of the hip the damage to the soft parts by the original injury is very slight, and if reduction is promptly secured there is little or no swelling, and there is less need, therefore, for attention to the soft parts during the course of treatment than in fractures of the legs, forearm, or elbow, where the swelling may be marked.

Now I want to call to your attention, in connection with fractures, the very scandalously bad results that actually occur. A number of years ago the American Surgical Association became convinced of the necessity for establishing some uniform record for fracture cases in order that deficiencies in treatment and in end-results might be recognized. Their Committee on Fractures in 1915 succeeded after much difficulty in collecting from various parts of this country and Canada records of nearly 2000 cases of fracture of the long bones. Of these, only 829 were reported in sufficient detail for purposes of investigation. From a study of these cases they found that the average period of disability was very much longer than anyone realized, that is to say, the average period during which the patient was incapacitated for work.

TABLE I

Average Period of Disability

Humerus, shoulder	11.5 weeks
Humerus, shaft	14.0 "
Humerus, elbow	9.0 "
Radius and ulna, shafts	10.8 "
Femur, neck	8.1 months
Femur, shaft	7.1 "
Tibia and fibula, shafts	4.9 "
Ankle	4.9 "

This table (Table I) which I present now shows the average period of disability, and you will be surprised to learn that in the average case of fracture of the leg, for instance, it will be five months before your patient is able to resume his normal occupations. That is to say, if I should break my leg this afternoon going home from the hospital it would be the first of April under ordinary circumstances before I would be able to walk about on it again as I am doing today.

Now it is incumbent upon surgeons to endeavor by all means in their power to reduce this period of disability. The further investigations of the Committee on Fractures of the American Surgical Association involved answers to the following questions:

Does a good anatomic result lessen the period of disability? Their records showed that if good anatomic results are obtained 69 per cent. of fractures of the femur will recover function within six months, as compared with 53 per cent. if the anatomic result is moderate, and only 38 per cent. if the anatomic result is bad. When good anatomic results were obtained in fractures of the leg bones 92 per cent. of patients recovered function within six months, as compared with 80 per cent. if anatomic results were moderate, and only 25 per cent. if the anatomic result was bad.

TABLE II

Fractures of the Long Bones

		Functional results		
Anatomic result.	Total.	Good.	Moderate.	Bad.
Good.......	469 (57%)	397 (85%)	61 (13%)	11 (2%)
Moderate....	251 (30%)	126 (50%)	98 (39%)	27 (10%)
Bad........	109 (13%)	22 (20%)	26 (24%)	51 (56%)
Total.....	829 (100%)	545 (65%)	185 (22%)	99 (12%)

This next table (Table II) shows the anatomic and the functional results secured in these 829 cases which were investigated by the American Surgical Association. It is scandalous, in the first place, to notice that only 57 per cent. of the patients secured good anatomic results. That is to say, in 43 per cent. of the cases accurate reduction was not obtained, and of the whole number of the fractures only 65 per cent. secured a good functional result. The table clearly shows that good function depends very largely upon accurate reduction of the fractures. But you will see, and it is true, that fractures in children under fifteen years of age do not require to be reduced with as great accuracy as fractures in adults; let us look, for instance, at the tables (Table III) published by this Fracture Committee, classing in one category all the patients under fifteen years of age and in another all those over fifteen years of age; we come to this startling result, that whereas 87 per cent. of the children secure good functional result, only 52 per cent. of the adults secure good function. This difference is due largely to the fact that reduction, accurate anatomic reposition of the fragments, is by no means so important in children as in adults, although, as you will see from this table, it was secured in 70 per cent. of the children, while it was secured in only 49 per cent. of the adults.

TABLE III

Influence of Age on the Functional Result

Anatomic result, under fifteen years.	Total.	Functional results		
		Good.	Moderate.	Bad.
Good	221 (70%)	209 (94%)	11 (5%)	1 (0.5%)
Moderate	80 (25%)	63 (79%)	15 (18%)	2 (2%)
Bad	17 (5%)	6 (35%)	3 (17%)	8 (4%)
Total	318 (100%)	278 (87%)	29 (9%)	11 (3%)

Anatomic result, all over fifteen years.	Total.	Functional results		
		Good.	Moderate.	Bad.
Good	248 (49%)	188 (75%)	50 (20%)	10 (4%)
Moderate	171 (33%)	63 (37%)	83 (48%)	25 (14%)
Bad	92 (18%)	16 (17%)	23 (25%)	53 (57%)
Total	511 (100%)	267 (52%)	156 (30%)	88 (17%)

How are we to secure accurate anatomic reduction in fractures? In most fractures near joints it is possible to secure reduction bloodlessly, and to maintain the correct position of the fragments by the position in which the limb is dressed—note what I say—first secure reduction, and then maintain it by proper position. Let me show you these *x*-rays of an ordinary supracondylar fracture of the humerus (Fig. 57), which the physician in charge thought he had reduced merely because he dressed the elbow in acute flexion. As you will see, the fracture was not reduced (Fig. 58); but after it had been properly reduced (Fig. 59), you see at once how securely reduction is maintained by the position of hyperflexion, as I call it, not merely of *acute* flexion. And it is a thing which is not appreciated as it should be by the profession, that many joint fractures require considerable force for reduction to be secured; but *one must not apply the force blindly:* first unlock the fragments, usually by increasing the deformity already present; then make longitudinal traction until they pass into proper relation the one to the other, and finally maintain the reduction by the position in which the limb is dressed. In this elbow, for example, to secure reduction (which had failed in the previous attempt by another physician) I at first *hyperextended* the elbow, unlocking the joint fragment from the shaft; then I made *longitidunal traction* upon the forearm, in the slightly hyperextended position, until I thought the lower fragment was pulled past the end of the shaft; and finally I brought the forearm up on to the arm directly in the sagittal plane (neither in adduction nor in abduction) into the position of hyperflexion, and by this term I understand *flexion as acute as possible.* If the reduction is accomplished soon after the injury, no anes-

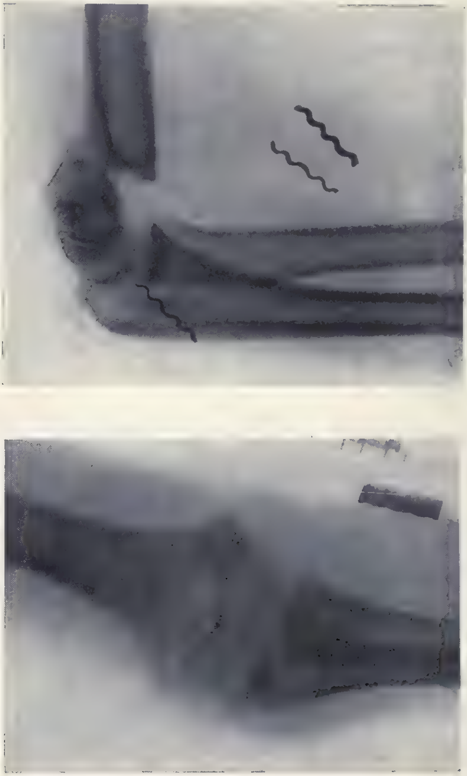

Fig. 57.—Supracondylar fracture of the humerus, on a right-angled splint, before attempted reduction. (See Figs. 58 and 59.)

thetic may be necessary, but when previous attempts have proved unsuccessful, it is usually wise to have the patient anesthetized. But even in some joint fractures, and in very many fractures of the shaft of long bones it is impossible to secure anatomic reposition by manipulation. And in many shaft fractures I maintain that such reduction, such absolute anatomic reposition, is not necessary to secure good function. This, of

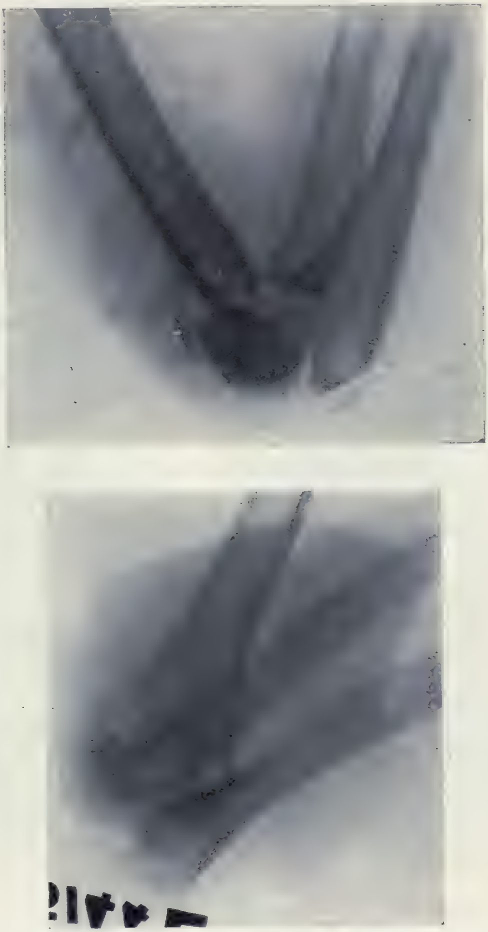

Fig. 58.—Supracondylar fracture of the humerus, after attempted reduction; the elbow is in "acute flexion," but not in "hyperflexion." (See Fig. 59.)

course, is particularly true in children; but, even in them, fractures near joints should be brought into as absolute anatomic reduction as is possible.

If we cannot secure reduction without operation, what are the results of operation? The Fracture Committee of the American Surgical Association found that even by operative means anatomic reposition was secured in less than three-fourths of the cases: in 72 per cent. only of those in which operation was done; and they further found that if anatomic reposition is not to be

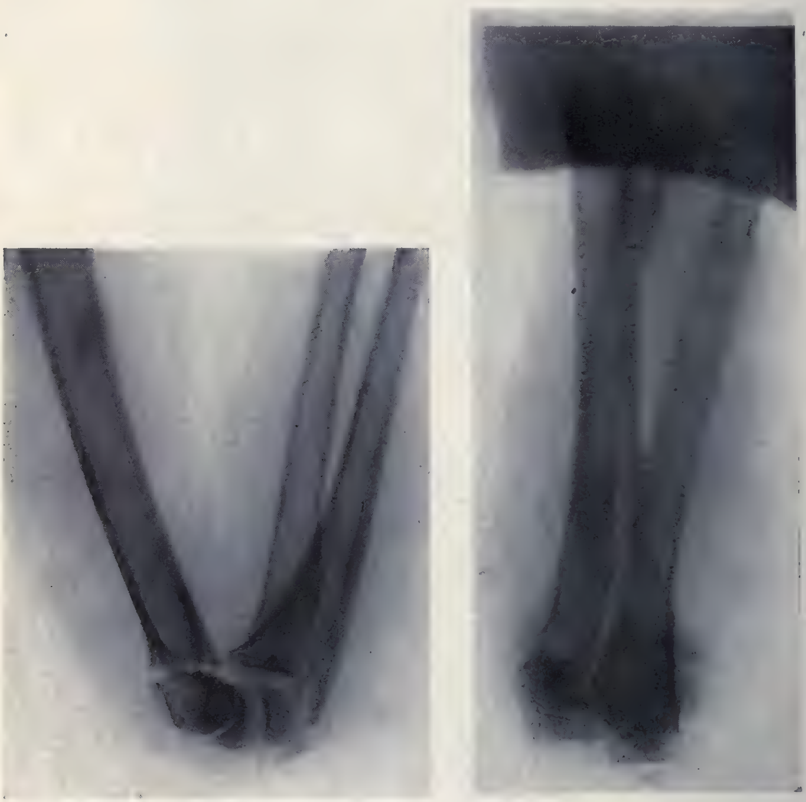

Fig. 59.—Supracondylar fracture of the humerus: reduction secured, elbow dressed in "hyperflexion." Note also that the anteroposterior view (on right) shows forearm bones and humerus nearly in same plane, and compare this with the anteroposterior view in Fig. 58.

secured, but only approximate reduction is to be obtained, very much better function follows non-operative than operative treatment—55 per cent. of good function compared to 21 per cent. Therefore it is evident that unless anatomic reposition of the fragments is obtained by operation the slight improvement in the position of the fragments that is obtained thereby does not compensate for the additional injury to the soft parts entailed by operation. So that I will beg of you that when you propose doing an operation on a fracture you will stop to consider whether you are reasonably certain of obtaining accurate anatomic re-

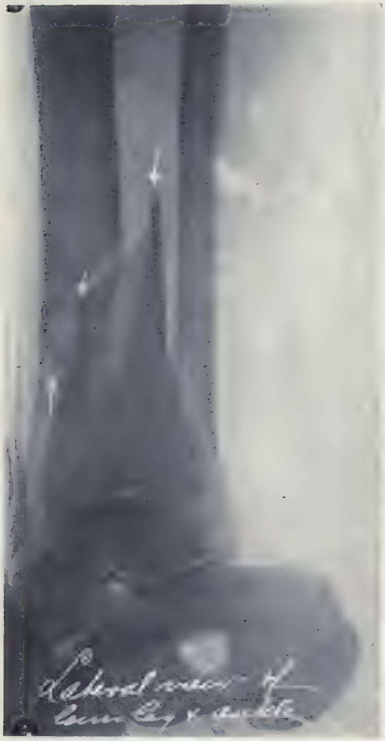

Fig. 60.—Spiral fracture of tibia in lower third, lateral view.

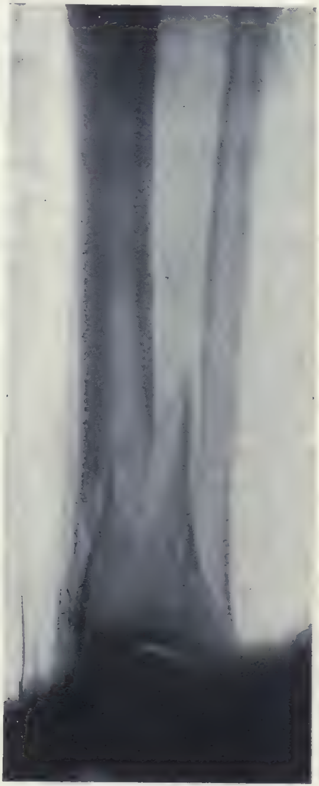

Fig. 61.—Spiral fracture of tibia in lower third, anteroposterior view.

duction. If not, you will do better to leave the fracture unreduced.

But, as I said before, there is a great difference between the *fractures of the shafts* and *joint fractures;* for it is very much more

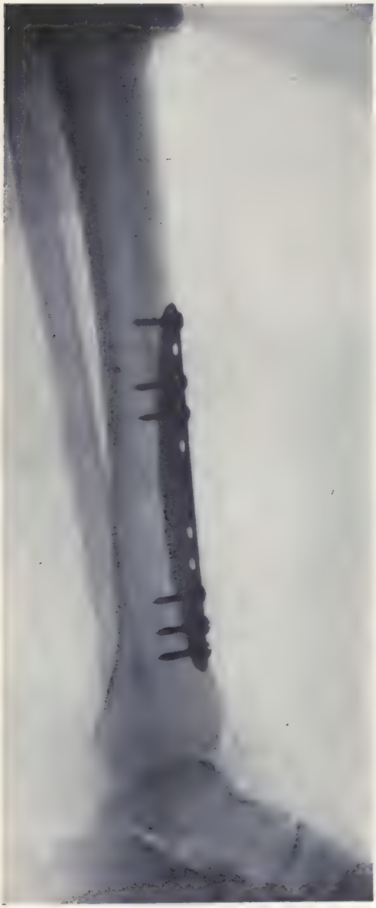

Fig. 62.—Fracture shown in Figs. 60 and 61 after operation. Lateral view.

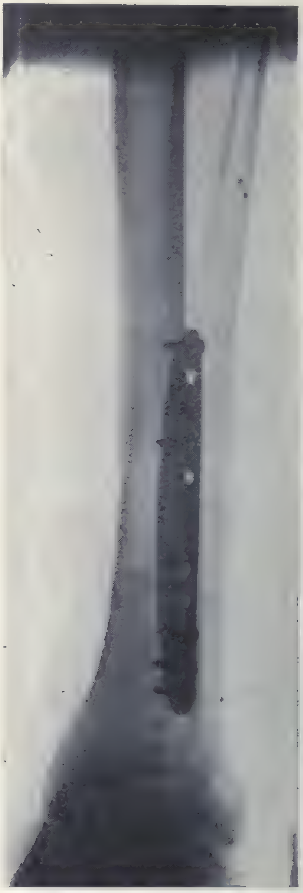

Fig. 63.—Fracture shown in Figs. 60 and 61 after operation. Anteroposterior view.

important to secure accurate anatomic reposition of the fragments in the case of joint fractures than in the case of fractures of the shaft of long bones. In the shaft fractures bad functional results follow bad anatomic results only in half the cases; whereas in joint cases a bad anatomic result insures a bad functional in over three-fourths of the cases (77 per cent.).

Now these figures being known and before the profession since 1915 it is incumbent upon all surgeons to ascertain in the first place what are the results of their own treatment of fractures; and if they are any better than the average they should by all means let the profession know about it.

This child upon whom I have just operated I am quite sure will secure a return of function in less than the average time, that is to say, it will not be five months, it will not be three months I believe before she is walking around on her leg as if it had never been broken. I have recently had under my care a physician who fractured his leg walking along the street, and I told him that looking at his *x*-rays (Figs. 60, 61) it was evident that unless accurate anatomic reduction was secured he would be "out of work," and he would be unable to walk as he walked before he broke his leg, for at least four and perhaps five months, but that it seemed to me in his case if the fracture was reduced by operative means he would secure full return of function within three or at the most four months. And as you see in the *x*-rays (Figs. 62, 63) which I show you, taken after operation, accurate anatomic reposition was secured and the patient is now walking about, ten weeks after operation, using a cane merely as a matter of self-protection, and I believe that very shortly he will be restored to his original excellent condition.

RECURRENT POSTERIOR DISLOCATION OF THE HIP FOLLOWING INFANTILE PARALYSIS, PARALYTIC VALGUS OF THE RIGHT FOOT, AND CALCANEO-VALGUS OF THE LEFT FOOT

The next patient, who is now being etherized, is a boy eleven years old, who had an attack of infantile paralysis at the age of nine months. He has worn braces ever since he began to walk.

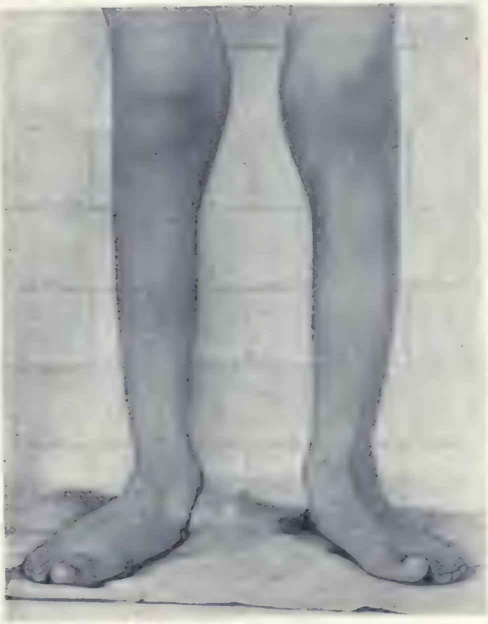

Fig. 64.—Talipes valgus on the right and calcaneo-cavo-valgus on the left following infantile paralysis.

His family never consulted any physician for the disability which remains, but someone who is interested in the family complied with his wish that something should be done for his disability. I am told that every night when he says his prayers he prays to the "Good Man Above," as his caretaker expresses it, that something will be done to improve his locomotion. He is very unsteady on his feet even wearing the braces, which extend to the middle of his thigh. Both feet incline to valgus (Fig. 64), he walks with a bilateral sway, and examination shows that the right hip slips in and out of the acetabulum when the thigh is adducted and slightly flexed (Figs. 65, 66). Except for a little weakness of the internal rotators of the right hip, there appears to be no paralysis except in the foot. This right foot is in marked valgus. There is paralysis of the anterior and posterior tibial muscles and weakness of the calf muscles. There is overaction of the extensor proprius hallucis, which is endeavoring by hyperextending the great toe to supplant the anterior tibial in raising the toes from the ground as the child walks. The left foot is in marked calcaneovalgus position. There is paralysis of the tibialis posticus and calf muscles and of the flexors of the toes; the

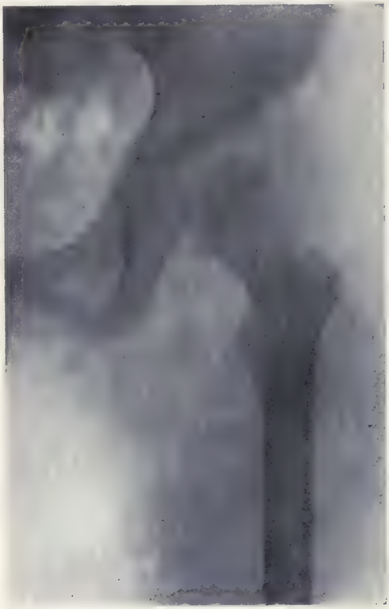

Fig. 65.—Right hip is now in acetabulum.

peronei and the posterior tibial tendons ride forward on the surface of and almost anterior to the malleoli owing to the marked descent of the heel, which is so great, the boy tells me, that in drawing on his long legged drawers he always has to put his heel in first, the foot lying up close along the anterior surface of the leg (Figs. 67, 68).

I propose today to operate on the right hip and the right foot, and at a second sitting, a week or ten days hence, to operate on the left foot. I have had 2 patients before with recurrent paralytic dislocations of the hip, one a boy of five years, the other a girl of seventeen years. In both of them the condition was relieved and the dislocation remained reduced when last heard from (after intervals of eighteen months and nearly two years, respectively) by pleating the capsule of the hip-joint. I make an incision from the anterior superior spine of the ilium to the great trochanter, divide the fascia lata and the tensor

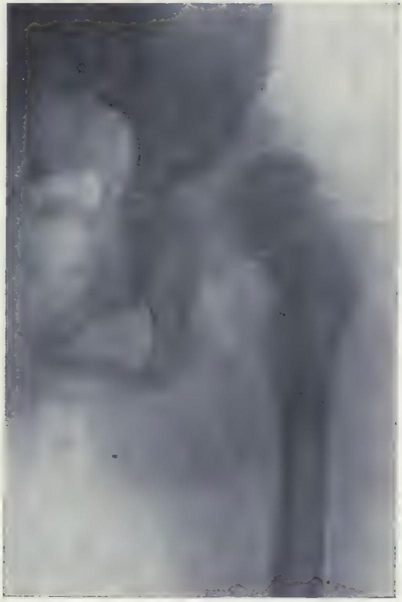

Fig. 66.—Very slight adduction and flexion allows dislocation of the femur upward and backward.

fasciæ femoris in the same direction, and identify the anterior border of the gluteus medius whose fibers run parallel with the incision. This muscle is the chief internal rotator of the hip, and it is because of paralysis of it or of some of the shorter muscles running from the pelvis to the back of the great trochanter that this recurrent dislocation occurs. The capsule when ex-

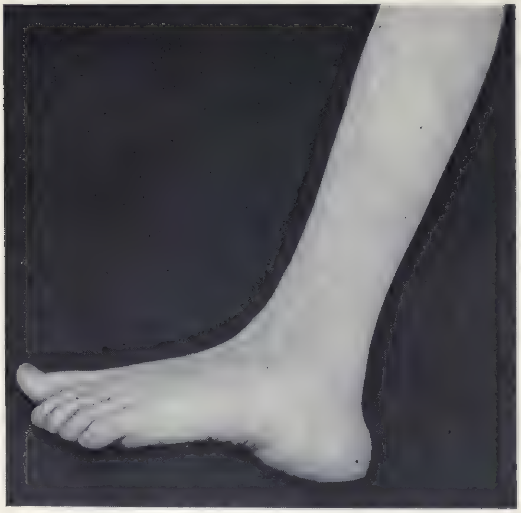

Fig. 67.—The left foot at rest, showing calcaneus and cavus.

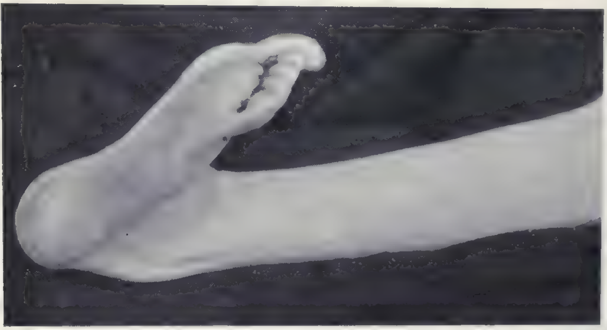

Fig. 68.—The left foot, showing extreme calcaneus deformity.

posed is found to be thickened, and on incising it from the anterior inferior spine of the ilium to the top of the great trochanter an excess of joint fluid exudes which is evidently due to the constant trauma of the joint produced in walking by the recurrent dislocation. The incision in the capsule is continued downward and forward along the anterior intertrochanteric line, raising a flap of capsule, including the Y-ligament, the strongest part of the capsule. The head of the femur being now replaced within the acetabulum (Fig. 69), this triangular flap of capsule is drawn upward on the superficial surface of the capsule above the head and neck of the femur and is sutured in this position by three mattress sutures of chromic catgut No. 2. The free edge of the flap is also sutured to the capsule above and slightly behind the femoral neck (Fig. 69). The soft parts are closed in layers.

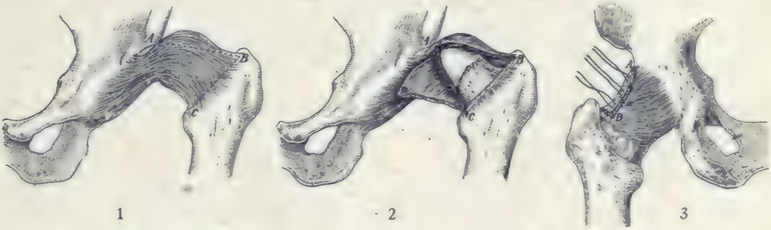

Fig. 69.—Capsulorrhaphy for recurrent dislocation of the hip-joint: 1, Incision from anterior inferior spine to great trochanter, thence along anterior intertrochanteric line. 2, Flap turned down, giving access to acetabulum, for gouging, etc. 3, Posterior view of hip-joint showing method of overlapping capsule by mattress sutures.

In one boy with recurring posterior dislocation of the shoulder-joint, in a case of infantile paralysis, I formed a strong bandlike ligament of fascia lata, fastening one end of it to a tunnel through the base of the spine of the scapula, above and behind the glenoid, and the other end to the greater tuberosity of the humerus; this effectually prevented dislocation, and when seen recently, nearly four months after operation, the stability of the shoulder was good, and its function improving. But in the hip, where there is already available so strong a capsule, I believe a free transplant is unnecessary.

Next I will do an arthrodesis of the subastragalar joint on the right foot. The subastragalar joint includes both the astragalocalcanean joint and the astragaloscaphoid joint. It is the joint in which lateral motion occurs below the ankle. The astragalus is fixed to the os calcis by a strong interosseous ligament dividing the astragalocalcanean joint into anterior and posterior compartments. The joint is entered by a short incision in front of the external malleous just above the peroneal tendons, and we gouge the cartilaginous surfaces of the astragalus and os calcis both in front of and behind this interosseous ligament until they are utterly denuded of their cartilage; the interosseous ligament is totally destroyed, the object being to convert the astragalus and os calcis into one bone. Sometimes it is possible through this same incision to get an instrument into the astragaloscaphoid joint and similarly to denude the opposing surfaces of the astragalus and scaphoid in order to secure ankylosis there also, but as in this patient I wish also to transplant the extensor proprius hallucis into the scaphoid and enable it to work to better advantage in the place of the paralyzed anterior tibial, I will make a separate incision just along the lateral margin of the tendon of the paralyzed tibialis anticus and do an arthrodesis through this incision of the astragaloscaphoid joint. Then I draw over the tendon of the extensor proprius hallucis, divide it across at the proper level, suture its distal end into the tendon of the extensor communis digitorum, and fix its proximal end into a groove cut in the scaphoid at the insertion of the tibialis anticus. The soft parts are closed in layers with chromic catgut and a plaster cast is applied from the toes around the pelvis and thorax, fixing the hip in slight abduction and the foot in a position of slight varus.

The operation on the left foot, which will be done, as I say, in a week or ten days, will consist in another operation devised by the late Dr. G. G. Davis, known as *transverse horizontal section of the tarsus.* I say another operation devised by Dr. Davis because I believe that the operation of substragalar arthrodesis, as we know it in Philadelphia and which seems to be unknown in other parts of the country, is an original invention of Dr. Davis.

The operation of horizontal section includes an arthrodesis of the astragalocalcanean joint, and then the tarsus from the anterior extremity of this joint is sectioned horizontally forward until the section emerges on the dorsum of the tarsus in the region of the scaphoid and cuneiform bones beneath the extensor tendons. These, as well as the lateral ligaments of the ankle-joint, must be thoroughly separated from the bones in order that the lower segment of the tarsus comprising the os calcis, cuboid, and lower portions of the scaphoid and cuneiforms may be shoved backward upon the astragalus and leg bones. The peroneal tendons will also be transplanted at the same time into the insertion of the tendon of Achilles, and in this way the valgus will be overcome, the foot will have lateral stability, and the heel will project so far backward and the leg bones will come to occupy a place over the apex of the cavus deformity in such a way as to flatten out the cavus deformity and give good leverage to the transplanted peroneal muscles in their efforts to elevate the heel.

(The operation of transverse horizontal section was done on the left foot November 16th. Recovery was uneventful, and the patient was sent to his home November 22d, still wearing his gypsum dressings. These will be renewed about six weeks after operation, but walking will not be permitted for at least ten or twelve weeks after operation, and braces will be worn for several months to furnish support to the feet. It is expected that the braces may be permanently discarded thereafter and that the boy will walk with normal stability, even though with a slight limp in the left leg, which is shorter than the right.)

CYSTIC OVARY

In the next patient we have diagnosed a cystic ovary. She is a young woman, twenty-six years old, whose menses began at fifteen years, with five days' duration at intervals of thirty days, with considerable flow. Her first child was born in 1913, a normal full term delivery; the child is now living and well. In 1917 she had a three weeks' premature baby and after this pregnacy the patient did not menstruate for ten months, after which time she menstruated every two weeks, the flow being of seven days' duration, with considerable pain and a sense of soreness in the pelvis. In March, 1919 she was in this hospital under Dr. Neilson's care and he removed her appendix. The tubes and ovaries were normal at that time, but the patient had a profuse leukorrhea and a smear was positive for the diplococcus of Neisser. She felt better for a while after this operation, but comes back now complaining of pain in the pelvis, a tender mass being palpable on the right side of the midline, evidently the ovary. The perineum is lacerated bilaterally, but causes no symptoms. There is no cystocele; the cervix presents a bilateral laceration, is soft, and it points toward her left; it is freely movable. The fundus of the uterus is anterior, freely movable, tender, and to the right of it inder the abdominal wall is this freely movable, tense tumor about 3 to 4 cm. in diameter, about which she complains. The fundus appears so close to the abdominal wall that if the history of the other operation were not available it would seem that a ventrosuspension had been done.

I make an incision 10 cm. long to the left of the median line and, opening the peritoneal cavity, find no adhesions at all. The appendix site presents no lesions; the fundus of the uterus is anterior; both ovaries are cirrhotic, the left small and atrophic, the right enlarged, and as it was the tender one, it is removed, the tube being left intact. The uterus is rather larger than normal and gives the impression that it is the seat of a chronic metritis, but owing to the patient's youth it will be better not to do hysterectomy until the condition becomes more pronounced, as the uterus may still be capable of functioning. However, there is a varicocele in the right broad ligament, and as the round ligaments have slipped from their normal site, allowing sagging of the uterus, they will be reattached near the uterine cornua by interrupted chromic catgut sutures. The wound is closed in layers. It is probable that she had a gonococcic infection before her admission to the hospital in 1919, but that this has been largely overcome without involving the tubes. However, I expect she will return in the future to this or some other hospital demanding relief for further pelvic complaints.

(The wound healed normally, the patient left her bed two weeks after operation, and was discharged from the hospital November 24th, being entirely relieved of her symptoms.)

UMBILICAL HERNIA

(Operation was done by Dr. Irvine M. Boykin.)

This patient, a very stout woman, has had an umbilical hernia for several years. About eighteen months ago she was operated on for gall-stones, and since then her umbilical hernia has continued to enlarge. She has now decided that it is a useless encumbrance, and came to the hospital a few days ago with the request for an operation. It is curious how long patients will put up with a certain amount of discomfort rather than interrupt the usual routine of their lives even for a few weeks. Recently a patient who had had an umbilical hernia the size of an orange for seven or eight years noticed while at work that the front of her dress was soaked with blood. She hurried to the hospital and, on undressing her, Dr. Hawfield (the Chief Resident Physician) found the bleeding (which was profuse) came from a varicose vein in the extremely thin skin covering the hernial sac; bleeding was soon checked by pressure, with the patient recumbent. It was only this complication which brought the patient to the hospital; but when she was once safely in bed in the hospital it did not take very much persuasion to convince her of the desirability of being permanently relieved of her hernia by operation.

INCOMPLETE ABORTION

While my associate, Dr. Boykin, is operating on this patient with umbilical hernia, I wish to say a few words to you about the subject of incomplete abortions. You will see that I had a case listed next after the umbilical hernia. We have in this hospital, unfortunately, a large number of women who come in with incomplete or threatened abortions, or having just recently had an abortion at their homes. Many of them will acknowledge that the abortion was self-induced, and it becomes our duty in this hospital to take care of these patients. The patient whom I had listed for this morning came in three or four days ago and told us that she had had eight children and that when she went two days over her regular period she thrust a slippery elm stick into her uterus because she did not wish to have any more. When a patient such as this is admitted with no history of having an abortion and it is uncertain whether the product of conception is still viable or not, it is, of course, our policy to await developments. This patient was bleeding a little. We put her to bed, raised the foot of the bed, and hoped that perhaps her attempt at abortion had been unsuccessful, especially as it was uncertain whether she was even pregnant, but she continued to bleed to such an extent that it was evident that abortion was inevitable and yesterday afternoon her condition was evidently not as good as it had been in the morning. Therefore it seemed best to evacuate the uterus at once and not put it off until today. (The tissue from the uterus was reported by our pathologist, Dr. C. Y. White, as containing placental tissue.)

If the patients give a history of having aborted before admission they are at once anesthetized and with due aseptic care the cervix, if necessary, is dilated and a blunt placental forceps is introduced, cautiously exploring the interior of the uterine cavity. On my service a curet is never used for these cases, nor is a sharp curet used for any purpose at any time. The tissue that is removed by the curet is invariably sent to the laboratory to be examined, and on one or two occasions we have been rewarded for persistence in this routine by having the laboratory report the presence of chorio-epithelioma. Of course, if such a condition as this should be overlooked and a malignant tumor allowed to develop in the uterus, operation of any kind when the patient began to present symptoms would be almost useless. One patient on whom I did a complete panhysterectomy under circumstances of this kind is now free from recurrence and in good health seven years after the operation, although the chorio-epithelioma was well developed at the time of the miscarriage.

There is very great danger of penetrating the uterus in evacuation after abortions, and that is the reason why the use of the curet is not countenanced. It is sufficient, as I have said, to introduce a ring-bladed placental forceps, to open it widely, and then rotate it by alternately supinating and pronating the hand; when the cervix is large enough gauze may be introduced on the finger or over the end of a placental forceps and evacuation secured in this way. I have come to regard it as very important to do this evacuation invariably as soon as the patients are admitted. If one waits there will be a certain proportion of these patients who will develop sapremia, or even septicemia, the latter of which conditions is very nearly fatal, and even the sapremia is a complication which it is better to avoid than to relieve.

We have had during the last six months 29 patients of this kind in our ward[1]; only 2 of them have run any temperature at all after evacuation, and in both of them it fell to normal within a few days and the patients recovered uneventfully. In only 1 patient did death occur. This was a woman who had a miscarriage two weeks before admission, had no attention whatever at the time, and was admitted in the last stages of exsanguination and sepsis. She died within half an hour, before anything at all could be done to her.

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[1] These may be classified as follows:
- Incomplete abortions, 21.
  - Uterus evacuated on admission, 20 (all recovered).
  - Death within half hour of admission, 1.
- Threatened abortions, 7.
  - Recovered without aborting, 4.
  - Recovered after aborting, 3.

HEMORRHOIDS

The next patient that I have is a man, forty-three years old, with hemorrhoids. He has complained of these for the last ten years, and almost always during this time he has had a protrusion of the piles after his bowels moved. Lately the piles come down while he is standing at work, sometimes being extremely painful and bleeding freely. He works as a dyer, being constantly on his feet. His bowels have always been fairly regular. He has no shortness of breath, no swelling of the ankles, and apart from some cough in the mornings he is in good general health. His lungs and heart are normal, his liver is not enlarged, and his abdomen is otherwise negative. So that the hemorrhoids in this case must be attributed to his standing so much at work and not to any cardiac or hepatic condition.

It is convenient when you record an operation for hemorrhoids to identify the various hemorrhoids as if they were on the face of a clock, the uppermost point of the anus when the patient is in the lithotomy position being regarded as 12 noon and the opposite point as 6 o'clock. This man, then, we find has five piles located one at 12 noon, one each at 2, 5, 6, and 9 o'clock. It has been pointed out by Miles that there are three constant sites for piles, two on the patient's right of the anus and one on the left. These piles he terms "primary." Secondary piles are not always present and never more than four in number. They develop at other points of the anal circumference. The piles that this man has at the points corresponding to 2, 6, and 9 o'clock probably represent what Miles would call the primary piles and the others are secondary piles. In other words, any patient who has more than three primary piles may be regarded as having an advanced case.

The operation that I will do on this patient consists of ligation of the hemorrhoids. First we dilate the anus, introducing the two index-fingers side by side, and then by leverage of the wrists (as is indicated in the accompanying sketch, Fig. 70) dilate the anus gradually until the fingers are arrested by the tuberosities of the ischium. Having dilated the anus thoroughly the proctoscope is next introduced and search made in the interior of the rectum for any abnormalities. There appears to be nothing out of the way in this patient. Then each separate pile is grasped in the forceps and drawn well out of the anus (Fig. 71). If you grasp only one pile at a time and tie it off before searching for the next pile there is danger that the ligature on the first pile may become displaced during the subsequent manipulations. Therefore it is a rule always to clamp all the piles which are to be ligated at the same time, each with its several clamp.

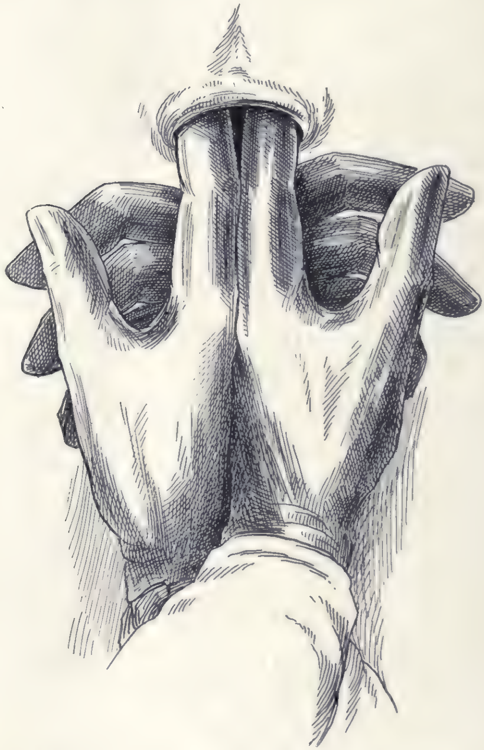

Fig. 70.—Digital dilatation of the anus.

Then with a scissors I snip a groove around the cutaneous margin of each pile, passing in a semicircle from the mucocutaneous juncture below the pile to the mucocutaneous juncture above the pile (Fig. 72, *A*). This groove is cut for two purposes: In the first place to make a fixed point in which the ligature can be tied and also to diminish the pain after operation, which would be very great if the ligature was tied tight enough to strangulate the pile over the intact skin. The groove being cut, a curved round needle armed with a long double ligature of strong linen or silk is passed from the middle of the groove which has just been cut through the base of the pile in the direction of the axis of the anal canal, emerging as high up as possible on the mucous

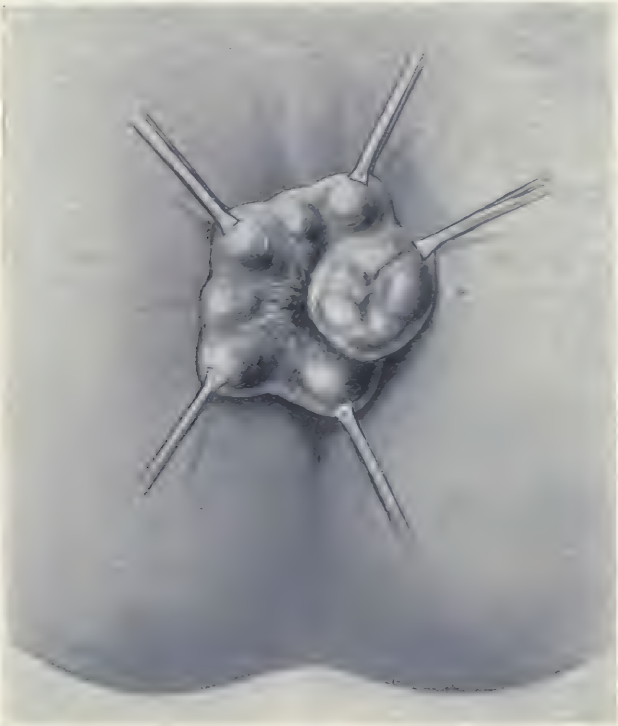

Fig. 71.—Each pile is grasped in its proper clamp, and drawn well out of the anus.

surface of the anus (Fig. 72, *B*). The long double ligature is cut near the needle and the two ends are tied tightly, one on each side of the pile (Fig. 72, *C*, *D*). These ends are left long. Some-

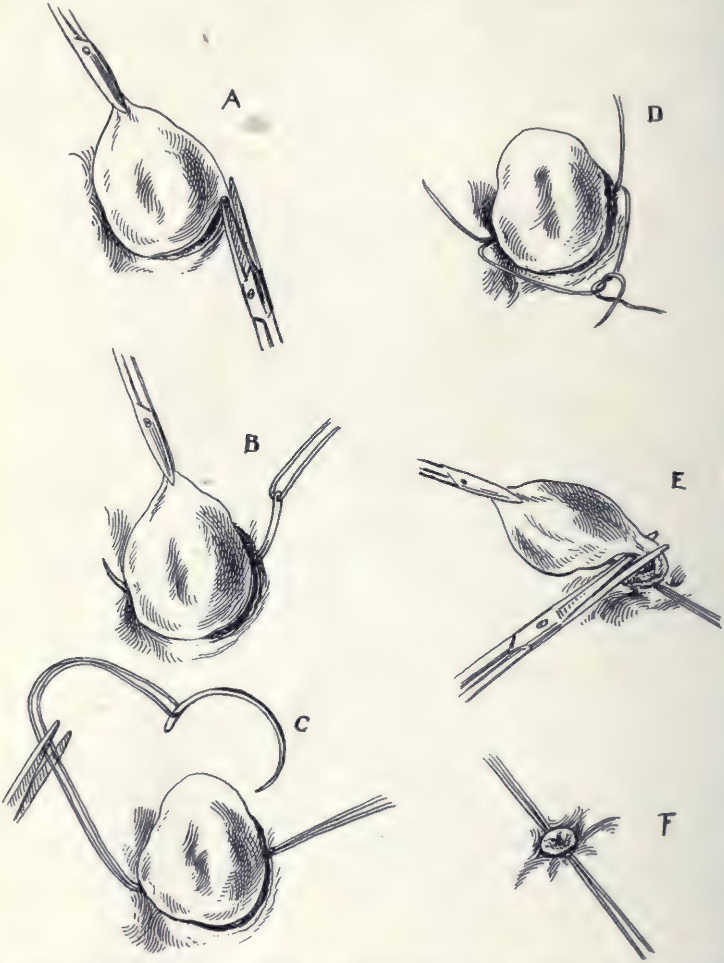

Fig. 72.—Method of ligating a hemorrhoid: *A*, Groove being cut along the cutaneous border of pile. *B*, Needle transfixing pile, in long axis of anal canal. *C*, The long double ligature is drawn through and divided. *D*, The double ligature is tied each side of the pile in the groove previously cut. *E*, The pile is cut off. *F*, Before cutting the ligature ends short the stump of the pile is carefully inspected for bleeding.

times one of them breaks while it is being tied and it is then convenient to have a second one to double back over the first half of the pile, after it has ligated the second half. Then while these ligatures are held taut by an assistant the operator cuts off the pile which protrudes beyond the ligature and carefully inspects the base of the pile for bleeding. Before the ligatures are cut short tension is relaxed and the pile allowed to retract, and again bleeding is looked for. The same process is repeated with each separate pile, taking care always to pass the needle which transfixes the pile in the long axis of the canal and paying particular attention to securing complete hemostasis. Now you may think that it is very unnecessary to take so much trouble over a simple operation like that for hemorrhoids, but it is because it is such a simple operation that it is unusually worth while taking trouble to make sure that nothing goes wrong. I was taught to do it in this way and I had always been taught that there was danger of hemorrhage. I never saw any hemorrhage occur until one time about a year ago when in the middle of the night a doctor who had operated upon a patient for hemorrhoids in the patient's house called me up and said that ever since the patient recovered from the anesthetic in the afternoon he had been passing clots from the bowel, sometimes as much as a pint at a time, and he said that the patient was evidently bleeding freely and he wished me to help him out. The patient was sent in to the hospital, anesthetized, and an intravenous injection of saline was given, and when I passed my finger into the anus large quantities of clotted blood and some fresh blood squirted out. The patient was very pale, his hemoglobin was 70 per cent. and his red blood-cells numbered only 3,070,000,[1] and he was very nearly dead from his hemorrhage; and the reason for it was that this doctor operating in the patient's house (I suppose with not a very good light) had not taken the precaution to make sure that his ligatures were placed sufficiently tight to check all bleeding. He did not cut any groove around the skin margins of the hemorrhoids and either at the time of operation or very soon afterward at least one of his ligatures had slipped and hemorrhage into the rectum began and only gave evidence of its pressure when the rectum became so full that the patient had to expel some of the clots. It was several days before this patient was entirely out of danger. So you see that the operation for hemorrhoids may be attended by complications unless it is done with great attention to detail, and that is the reason why I am trying to impress upon you today the importance of accuracy and care in the operation.

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[1] Findings such as these within a few hours of the onset of hemorrhage indicate a very severe degree of anemia. The red blood-cell count always shows a more prompt response to hemorrhage than does the percentage of hemoglobin. It was pointed out by Depage, early during the German War, that if the red blood-cell count fell below 4,000,000 *within six hours* of the injury, exceedingly few patients would recover without transfusion of blood.

The operation by clamp and cautery I scarcely ever use merely because I feel it is safer to have a ligature around the base of the hemorrhoid than to trust to the clot produced by the cautery. No suppository or any other local application except a dusting-powder to the surface of the pile is applied. A perineal pad is held in place by a T-bandage, and on the fourth day, if the bowels have not moved sooner, a dose of castor oil is given and the patient is kept in bed for from seven to ten days. Here again I know that many surgeons get these patients out of bed within a very short time, but I am convinced that patients with hemorrhoids as well as patients with many other comparatively slight operations do better if kept at rest until reparative processes are really well advanced.

CELLULITIS OF FOREARM AND THIGH

The last patient that I have for operation today is a baby six months of age, with suppurative cellulitis of the right forearm and hand and of the right thigh. The baby was admitted to the hospital two days ago. His mother died four months ago "from a stroke." It is said that she went insane after the birth of the baby and was sent to the Philadelphia General Hospital. As a consequence the baby did not get proper attention, but was taken to the Lankenau Hospital and was bottle fed there until September 21st. During the past week the baby's caretaker noticed that the fingers of the right hand were beginning to swell and then this swelling extended up the hand and forearm and redness appeared. She also noted that there were several sore places in the right groin. The baby's temperature on admission was $104\frac{3}{5}$° F., its pulse 140, its respirations 36, and it was very ill. The right index-finger and flexor surface of the wrist were red, hot, and swollen. In the right groin there was a furnucle with an area of redness and induration the size of the palm of the hand. In the right iliac region was a sore resembling a chancre. It is possible that the child has congenital syphilis in addition to its acute infection. The history of the mother having died "from a stroke" and being insane, although nothing else is known about the family history, is not inconsistent with the presence of syphilis in herself.

Yesterday the dorsun of the hand was incised by the ward resident and the child's temperature fell to $99\frac{3}{5}$° F., but rose again to $102\frac{2}{5}$° F. Today I want to open the hand further and also the forearm and the thigh. I will give the child no anesthetic, since it can be barely conscious of the pain until after the cut is made, when it will have no recollection of the previous momentary pain. Very small infants have neither anticipation of suffering to come nor recollection of that which is past; and when the constitutional condition demands it, one is quite justified in producing mometary pain. The forearm, as you see, on the flexor surface is tense and swollen, and I will make the first incision over the radial surface above the wrist, and here I find some purulent fluid. (The culture was subsequently reported as containing staphylococci.) The second incision I make over the ulna above the wrist; opening the pronator space, I find here no pus, but will leave in a drain of rubber tissue, as it is not unlikely if the child survives that pus will eventually be found in this neighborhood. The third incision I make on the dorsum of the hand over the index metacarpal, finding only necrotic subcutaneous tissue. You will see that I made my first incision where I was least apt to find advanced infection so as not to spread infection from the more infected to the less infected zones. In the thigh I make a crucial incision over the furuncle below Poupart's ligament, finding pus and necrotic fat. A moist dressing of 2 per cent. sodium citrate solution is applied to both areas of infection, a splint being placed on the forearm in order to enable us to maintain it in vertical suspension. By cutting little nicks each side of the splint where it protrudes beyond the hand and tying a bandage tightly around the splint through these nicks the splint and, therefore, the forearm can be hung up in vertical suspension. This is a valuable method in all cases of cellulitis, and it is surprising with what rapidity the swelling will go down under these circumstances.[1]

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[1] The baby was somewhat improved for a few days after operation. It took its nourishment better, its temperature gradually reached the normal, and had been normal two days before its death on November 10th, five days after operation. An autopsy was held which showed metastatic abscesses in both lungs, in the kidneys, and in the spleen. Cultures from these abscesses gave a growth of Staphylococcus aureus. The postmortem blood Wassermann was negative. (Drs. C. Y. White and A. A. Walkling.)

OPEN REDUCTION OF FRACTURE OF THE FOREARM (DRESSING)

Now we have a fracture of the forearm to dress, one which in many ways resembles the fracture of the tibia on which I operated this morning. This boy, who is thirteen years old, on whom I operated October 27th, was admitted to the hospital on October 19th. He slipped and fell with the left arm doubled up under him. He walked to the hospital and received treatment within an hour of injury. There was fracture of both bones of the forearm, compound of the ulna, and its upper fragment was projecting slightly through the skin on the ulnar surface of the forearm. It was evident that there was a fracture of both bones about their middle and there seemed to be some overriding. An *x*-ray showed that there was, in addition, a second fracture of the radius a little above the wrist-joint, and that while the other fracture of the radius and that of the ulna were in fair position, yet the lower fracture of the radius had the fractured surfaces not in contact at all (Fig. 73). The patient was first redressed on October 23d, four days after the accident, and it was determined that it would be necessary to secure reduction of the lower fracture of the radius by open incision.

Therefore the preparation for the operation was begun on October 25th and the operation was done on the 27th. Today I am going to do the first dressing since the operation, now ten days ago. He was dressed on a posterior splint made of plaster of Paris and on a right-angled splint fixing the elbow, with the forearm in full supination. As you will see, the *x*-rays made since operation (Fig. 74) show that while reduction of the lower fracture of the radius was secured, yet that in securing that reduction the upper fracture of the radius became disarranged, but that does not worry me very much because a fracture such as this was, far from either the elbow or the wrist and particularly in so young a patient, will almost invariably give a good result even if it is not accurately reduced. Moreover, the upper fracture of the radius and the fracture of the ulna are not at the same level, and there is, therefore, very little danger of one fracture interfering with the other. If they are both precisely at the same level it sometimes happens that the lower fragment of the ulna will unite with the upper fragment of the radius or vice versa, but, as I say, where the fractures are not at the same level such an occurrence could hardly take place.

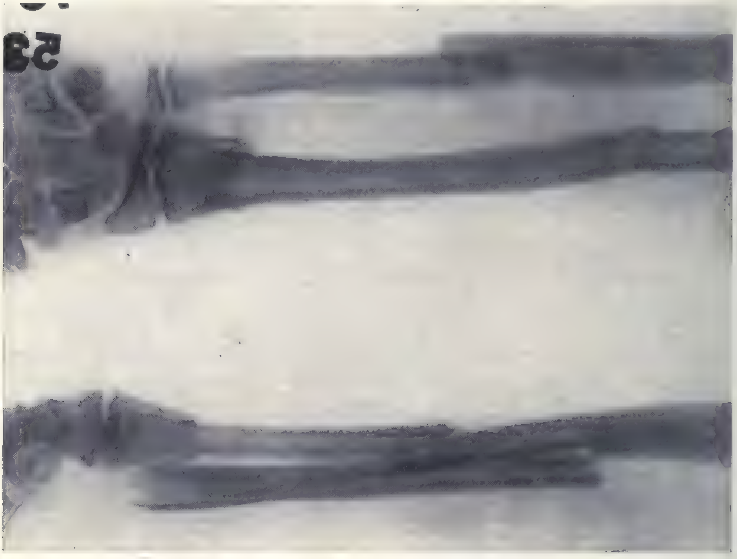

Fig. 73.—Double fracture of radius, and compound fracture of ulna, in a boy thirteen years of age. Note that middle fragment of radius is not in contact with either upper or lower fragment.

The splints have now been removed and I will raise the gauze covering the incision. You will see that it is entirely dry, although blood stained, except at one point, where it is a little moist. I should rather see the gauze entirely dried up, and as I draw this last layer of gauze away from the wound there appears to be one drop of pus between two of the sutures. We will take a culture of this, but I do not believe there will be any growth from it, for the boy has had no fever whatever since the operation, and there is not the least bit of induration or redness or swelling about the incision. (As a matter of fact, no growth could be obtained from this culture and at the second dressing the wound was entirely healed.)

The fracture will be redressed on an anterior and posterior splint, and after the second dressing, when I make certain that the soft parts have thoroughly healed, the boy will be discharged and referred to the dispensary for after-treatment.

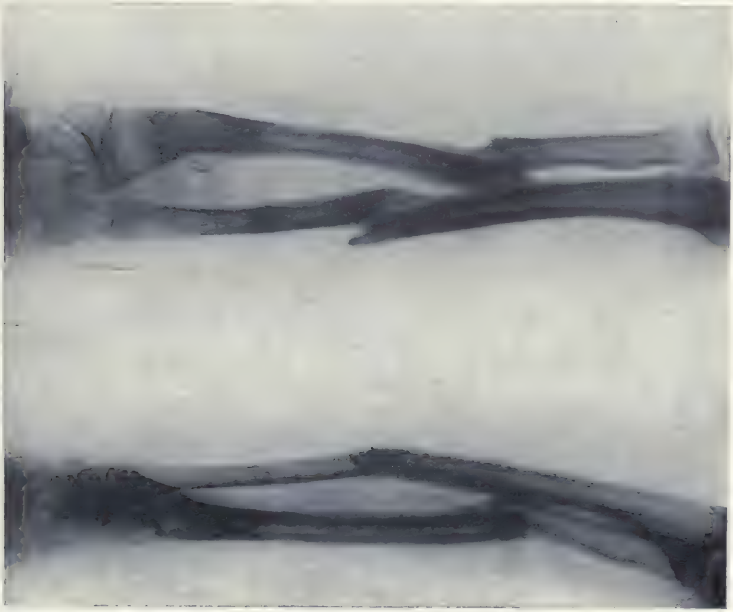

Fig. 74.—Fractures shown in Fig. 73, after open reduction of lower fracture of radius: good union in all the fractures, though the upper radial fracture is not in good alinement.

(The second dressing was made November 13th, the wound was found entirely healed and the boy was discharged.)

In this case the displacement of the fragments of the radius above the wrist was so marked that there was a suspicion that the median nerve was compressed. Immediately after the injury there was some hyperesthesia in the distribution of this nerve and the swelling of the hand was so great that for the first week after the accident he was unable, or unwilling, to move his fingers at all. At present, ten days after the operation, there is free motion in all the fingers, the swelling has entirely disappeared and when he has the splints off he can begin to oppose his thumb to his index and middle fingers.[1]

I have also 2 cases to show you which I think are of interest from the standpoint of diagnosis.

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[1] Splint was discontinued seven weeks after operation. Function of the hand was perfect, and there was rotation of the forearm from the position of full supination to that of midpronation. This rapidly increased.

TWO CASES OF EFFUSION INTO BOTH KNEES: ONE SYPHILITIC, THE OTHER HEMOPHILIAC

When I took the Children's Ward under my service on November 1st this year I found in the ward a boy five years old who was thought by my predecessor to have tuberculosis in the right knee. The boy is known to be a hemophiliac. His mother and father are living and well and there is no history of hemophilia in the family except that one brother was said to have been a bleeder and died at the age of ten months with bleeding from the gums. He has one sister living and well, three years old. This boy was admitted to the hospital September 24th under Dr. Deaver's care, and the history taken then says that his general health had been fairly good; he had had whooping-cough two months previously and his nose bleeds, it is said, very often; in fact, nearly every time he cries. Two weeks before his admission to the hospital he had a lacerated wound of his cheek, but there is no history of his having bled unduly at that time. However, he was in this hospital somewhat over a year ago, with persistent bleeding following a scratch on the finger. This bleeding continued for seventeen days after his entrance, and the record says that his hemoglobin fell to 20 per cent. His chief complaint on admission this year was pain in the right knee-joint. This began thirteen months previously and followed a sprain of the knee. He was in another hospital for six weeks at first, but the knee even after his discharge from that hospital continued swollen and tender and pained him, especially at night.

He is a poorly nourished, sallow complexioned boy, and the physical examination is negative except for the knees. The right knee is markedly swollen and on admission was tender. The overlying tissues at that time were hot to the touch; there was fluctuation in the joint and it was kept semiflexed. He was treated with extension to the knee and considerable improvement had occurred before the boy was transferred to my service on the first of this month. I found that there was effusion also in the left knee (Fig. 75). The circumference of the right knee was 25 cm. and of the left 23 cm. The right knee could be flexed only to 90 degrees, whereas the left knee flexed to 40 degrees; the patella floats in both knees.

x-Rays had been made, and they are negative for bone changes. Now it seemed to me that if this boy had had a tuberculous process in his knee for fifteen months, thirteen months before admission to the hospital and two months after his admission, surely by that time there should be some visible roentgenographic evidence of bone lesion. So that, although I am not very certain of the diagnosis, I was inclined at first to believe that the boy had hemorrhage into the knee-joints. Over the left anterior superior spine you see there is an ecchymosis about 2 x 3 cm. in diameter; there is general glandular enlargement in the neck, in the groin, and slight enlargement of the epitrochlear lymph-nodes on both sides. There are carious molar teeth on each side of the mandible, the tonsils are hypertrophic, the left nostril contains clotted blood, and on the right cheek are two scars from the lacerated wound noted above. Several times recently there has been some blood passed by the bowel.

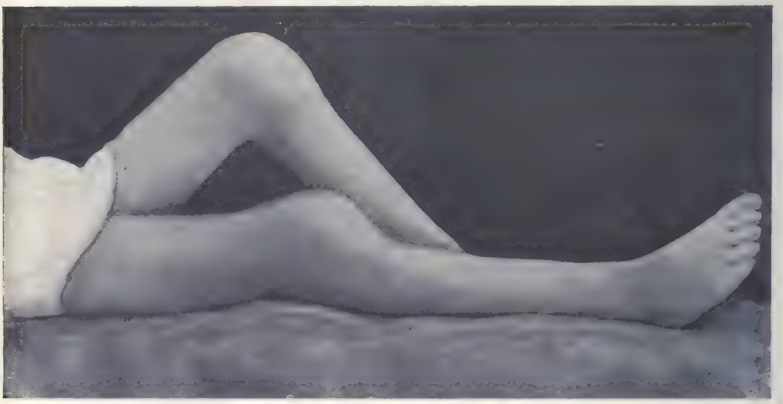


Fig. 75.—Effusion into both knees in a boy with hemophilia.

I have asked several other members of the staff to see this boy. Dr. Fussell asked for a complete blood-count, and the blood chemistry, especially the calcium content of the blood. Dr. Robertson thought that the general adenopathy indicated a tuberculous condition. Dr. C. Y. White thought it would be interesting to study the corpuscles of the blood, to investigate the chemistry of the blood, especially the fibrin content, and also to make a general chemical study of the patient's intake and output.

The trouble with all these requests, except the last, is that they involve the danger of bleeding, and I am not inclined to run that risk unless I could be convinced that something of a therapeutic nature could be done for the boy after the tests had been made. I asked Dr. Alonzo E. Taylor the other day about hemophilia, and he told me that physiologic chemistry could do nothing for such cases; that the fault was a biologic one and that it was necessary to treat the parents or grandparents of the patients; but when I told him that the patient that I had under my care at present might some day be a parent or a grandparent and there was now an opportunity for him to begin treatment three or four generations in advance—even then he could think of nothing that would do the boy any good. He tells me that in Servia he saw many cases of peri-articular hemorrhage from scurvy, but the effusion in this patient certainly is within the joint. I propose to put the boy's knees in plaster of Paris so as to immobilize them thoroughly and to adopt Dr. Robertson's advice of giving him 15 minims of hydrochloric acid in milk three times a day in an effort to increase the calcium content of the blood.

I should add, also, that the diagnosis of tuberculosis is not supported by *x*-ray examination of the chest, which is negative. It may be a case of congenital syphilis, but I do not like to run the risk of drawing blood for a Wassermann test. The boy, however, has just begun a course of iodids.

The second boy with effusion into both knees is ten years old and was admitted to the hospital day before yesterday (Fig. 76). As soon as I saw that he had effusion into both knees I thought of congenital syphilis, and when I noticed also the condition of his left eye I was positive of my diagnosis (Fig. 77). Then I inquired into his family history. His father died of lung trouble, his mother of pneumonia. Eight other children died at ages varying from seven to twenty-one years; there were some miscarriages, and only two brothers are living and well: the elder, who is the firstborn child, and now twenty-seven years of age, tells me he was himself a premature baby, and he is stunted in appearance, presents a saddle-nose, and facial characteristics of inherited syphilis in a mild degree. The other living child, now thirteen years of age, has "sore eyes and running ears," and is under treatment for these conditions in another hospital. Our patient was the last born child and, his eldest brother tells me, was the huskiest of the family. He has had measles and chicken-pox, but his general health has always been good. The condition of his left eye, according to his brother, developed when he was about two years old, but no attention seems to have been paid to it.

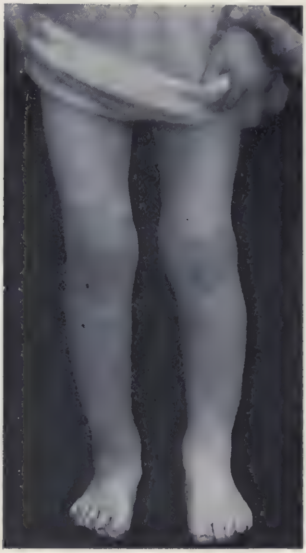


Fig. 76.—Effusion into both knees in a case of hereditary syphilis.

His chief complaint was a swollen knee-joint (the left), of which he first started to make complaints about two weeks before admission. The knee was slightly tender, but he could walk. There is no history of hemophilia or of injury. The blood Wassermann is +3. Dr. Goldberg examined his eyes and reported that in the left there is moderate ptosis, that the eyeball cannot be raised above the median plane; that there is a definite paralysis of the superior rectus and the superior oblique muscles from a nuclear lesion. The eyes are never upon the same plane. There is great difficulty in converging, especially in converging the two eyes at the same time. The pupils are regular and equal and react to light and accommodation.

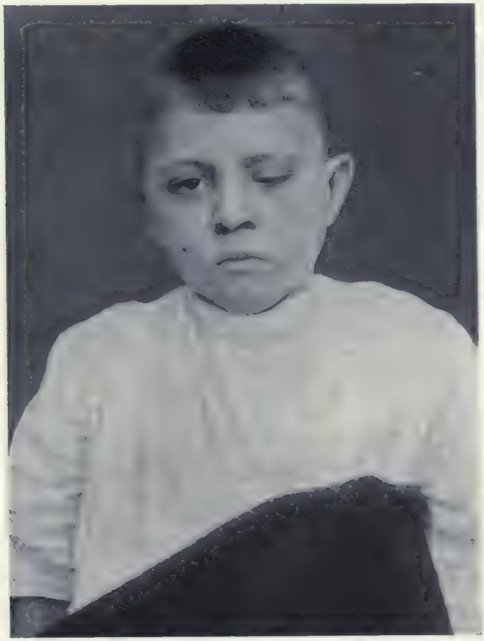


Fig. 77.—Ptosis and paralysis of extra-ocular muscles, from a nuclear lesion in a case of hereditary syphilis.

Now you will notice that the boy's mouth is also rather characteristic of congenital syphilis. There are rhagades in the midline of the upper lip. His posterior cervical and epitrochlear glands as well as those in the groin are palpable, but the axillary lymph-nodes I am not certain about. There is effusion in both knees and the patella floats. The left appears larger, but measurement shows that the circumference of each is 29 cm. They cannot be quite fully extended, the right can be flexed to 30 degrees and the left to 25 degrees.

Many of these cases of syphilitic knees are mistaken for and are treated for tuberculosis, but almost invariably the pain is not as great as in tuberculous disease; the lesions appear to be confined largely to the synovial structures, *x*-ray examination as in the present patient showing no lesion of consequence, at the most a little roughening of the under surface of the patella and of the internal condyle of the femur; and then the fact that usually multiple joints are involved in congenital syphilis is another diagnostic point of importance. Of course, to confirm this we have the family history, other syphilitic lesions in the same patient, and the Wassermann test. Constitutional treatment usually is all that is required to bring about rapid relief. If the joints are painful or if there is much effusion, as in this case, they should be put at absolute rest by being encased in plaster-of-Paris cases, but operative treatment is rarely, if ever, required.

(Improvement in both these patients was rapid and continuous: both boys became rosy and fat and happy; the hemophiliac's knees soon ceased to pain, and he walked all around the ward with his casts on; while the syphilitic's knees likewise showed progressive improvement, as did his ptosis and extra-ocular palsies.)

CLINIC OF DR. JOHN H. GIBBON

PENNSYLVANIA HOSPITAL

AMPUTATION OF THE BREAST FOR CARCINOMA; THE STEWART INCISION

Preliminary Considerations.—Before undertaking any operation for cancer of the breast it is important to determine that the case is a proper one for operation; contraindications as well as indications should be considered. Many cases of cancer of the breast which at first sight might seem to offer a good prospect of cure are really inoperable because the disease is too far advanced or because metastasis has already taken place. The insidious metastases to the spine and the mediastinum, especially in scirrhous carcinoma, should always be borne in mind. I have seen more than one case of this kind in which the patient sought relief for the spinal pain before she was conscious of the growth in the breast, and many more where a few weeks or months after the radical operation a spinal or intrathoracic metastasis manifested itself. A dry, chronic cough, shortness of breath on slight exertion, or a persistent soreness and stiffness in the back, which does not respond to the ordinary remedies for "lumbago," should make one hesitate to undertake a radical operation for cancer of the breast. Such a case should receive a painstaking physical examination and *x*-ray study. It is an old observation that the removal of the primary cancer causes more rapid growth in a coexisting metastasis, and my own clinical experience tends to confirm it. An amputation of the breast in the case of inoperable cancer does the patient no good, but does do surgery harm, for it confirms the wide-spread belief in the laity that surgery cannot cure cancer. This mistake brings even wider spread bad results, because other patients, observing the uselessness and futility of the operation, avoid it themselves, and turn to other ineffectual means of treatment during the operable period of their own disease. In other words, we are educating the public wrongly. How much better to say frankly that the patient has presented herself too late for operation. The effect upon her acquaintances afflicted in like manner is obvious, and in my opinion this is the right way to instruct the public. It is the duty of every physician to teach the public that surgery does cure a large percentage of cancers, especially of the breast, if it is early and radical surgery.

Do not be content to become skilful operators, but develop surgical judgment which will enable you to avoid surgical blunders. Tumors of the breast deserve just as careful study, just as careful physical examination, and the exercise of just as good surgical judgment as the diseases of the upper abdomen. It should be just as chagrining to the surgeon to remove a breast for cancer in the presence of a determinable metastasis in the spine or mediastinum as to remove a "chronic appendix" in the presence of a duodenal ulcer or a stone in the ureter. Each shows a lamentable lack of care and an exhibition of no surgical judgment.

The Patient.—The case to be operated upon this morning is that of a woman sixty-five years of age, in excellent health except for a small, hard, fixed tumor in the breast. The tumor was first noticed only four weeks ago, but it has existed undoubtedly for a much longer period of time. It is a scirrhous carcinoma which easily escapes the observation of the patient because it does not, as a rule, make a swelling which the patient can see or easily feel. Sometimes these growths are not discovered until the patient finds a "lump" in the axilla, a glandular metastasis, which is often larger than the primary growth. In the present case no glands can be palpated in the axilla, but one can be assured that glandular involvement will be found in the shape of small hard glands, many no larger than grains of wheat. A careful examination has revealed nothing to make one suspect the possibility of metastasis elsewhere. It cannot be too often repeated that glandula enlargement is not a symptom of cancer, but one of its sequelæ.

The Operation.—The incision constitutes a very important part of any operation and deserves careful planning. A badly placed incision hampers the operator in the subsequent steps of the operation, may necessitate the making of a second incision, or result in unnecessary disfigurement of the patient. In order to appreciate this one has but to consider an incision for inguinal hernia placed too high or too low, a vertical instead of a transverse semilunar incision in fracture of the patella, and incisions across the normal creases of the neck instead of in their floor. Probably the worst feature of a badly placed incision is that it does not give ready access to the tissues and structures to be dealt with later. A faulty incision is the most common mistake made by the beginner in surgery, and when made, is sure to lead to other and often more serious ones. The ideal incision is one which permits the best access to the structures to be dealt with, which does the least damage to the tissues through which it goes, which can be closed with the least disfigurement, and which results in the least disturbance of the normal relations and functions. Probably the most important desideratum is the first mentioned, certainly in dealing with malignant disease, but the others deserve consideration at all times. What, for instance, is the use of making a central incision for the removal of a thyroglossal cyst, an incision which will later give a wide and ugly scar, when just as good an exposure and practically no disfigurement can be had from a transverse incision?

Probably more incisions have been employed in amputation of the breast than in any operation in surgery. Up to the time when Francis T. Stewart described his incision before the American Surgical Association at Rochester, Minn., in 1915 (Annals of Surgery, Vol. 62, p. 252), the incisions which gave the best cosmetic results and interfered the least with subsequent function were the worst, because they did not include enough skin or did not give sufficient access to the tissues to be removed. Up to this time all the incisions which gave the best access and best enabled the surgeon to deal with the disease resulted in disfigurement and often disability. One might say that this should not be objected to in view of the fact that they were the result of the thorough removal of a malignant growth of the breast, but nevertheless, such incisions were not ideal. As it is my intention to lay particular stress today on the Stewart incision for amputation of the breast, nothing further will be said of any other except that in many of them too little skin is removed, in most of them there is too much subsequent disfigurement and in some a resultant loss of function due to the scar which extends from the chest to the arm.

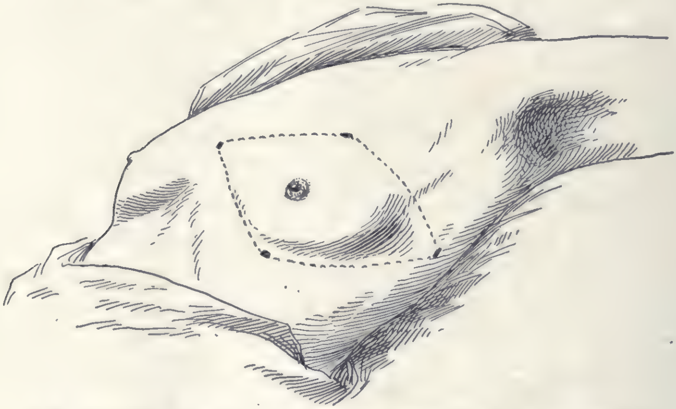


Fig. 78.—Outline of incision, showing extent of skin removed.

The incision of Stewart might be called the elliptic transverse incision, the ellipse including as much skin as is indicated. The exact situation of this elliptic incision may vary with the site and size of the tumor; that is, it should be placed higher when the tumor is near the upper periphery of the gland or lower when the tumor is near the lower periphery. This shifting of the lines of incision permits one to remove the skin above or below the breast as the situation of the tumor may indicate. A glance at the outline of the incision as shown in Fig. 78 would cause one to doubt the possibility of being later able thoroughly to expose the axillary structures. I can only say that I have employed this incision in 91 cases, and have felt that I obtained as good an exposure of the axillary structures as with any other incision. The other figures indicate the exposure which is obtained by thoroughly mobilizing and retracting the skin over the pectoral muscle and in the axilla. These drawings were made at the time of operation and represent its different stages. When the elliptic incision through the skin has been made the skin should be thoroughly mobilized both above and below the gland. The mobilization above should extend down the arm beyond the hair-line of the axilla.

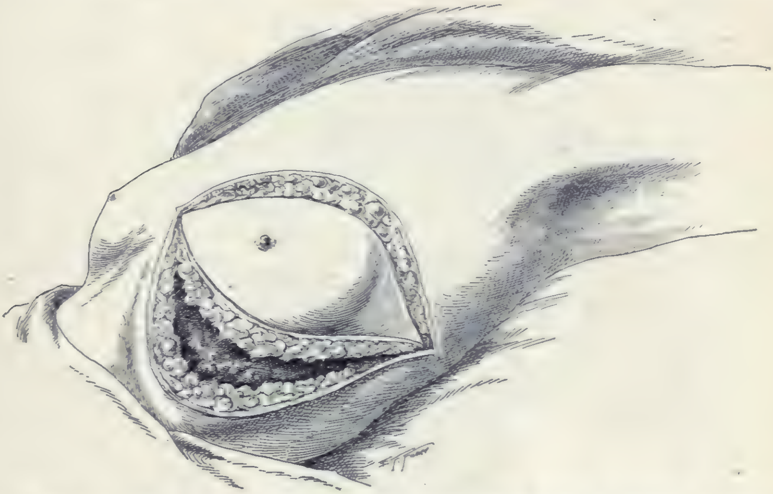


Fig. 79.—Mobilization of lower skin-flap, which facilitates closure of wound and the wide removal of fat and fascia with the breast.

One of the advantages to be gained from doing this mobilization at the beginning of the operation is that it permits one to remove more of the fat and fascia beyond the breast. With the mobilization and retraction of the axillary skin it will be seen that the pectoralis major tendon is exposed down to the point of its insertion.

The next step in the operation is to determine what structures are to be removed. It is my own custom in practically all cases to remove both pectoral muscles and a part of the sheaths of the latissimus dorsi and serratus magnus muscles. I think, however, that it is a bad plan to follow too routine a procedure, because if the growth is situated at the lower and inner quadrant of the breast I believe that it is much more important to remove the fat and fascia from the upper portion of the rectus than it is to remove the lesser pectoral muscle. The greatest advantage to be derived from the removal of the lesser pectoral is that the division of its tendon gives a much freer exposure of the glands along the axillary vessels and permits their more thorough removal. In this case we will first separate the clavicular from the pectoral portion of the pectoralis major and then divide the pectoral portion of the tendon near its insertion into the humerus. This portion of the muscle is then reflected, the tendon of the lesser pectoral isolated, and divided near the coracoid process. The glands and the fat of the axilla are then separated from the vessels and reflected with the muscles. At this time the posterior axilla is given careful attention, all the fat overlying the subscapularis muscle and

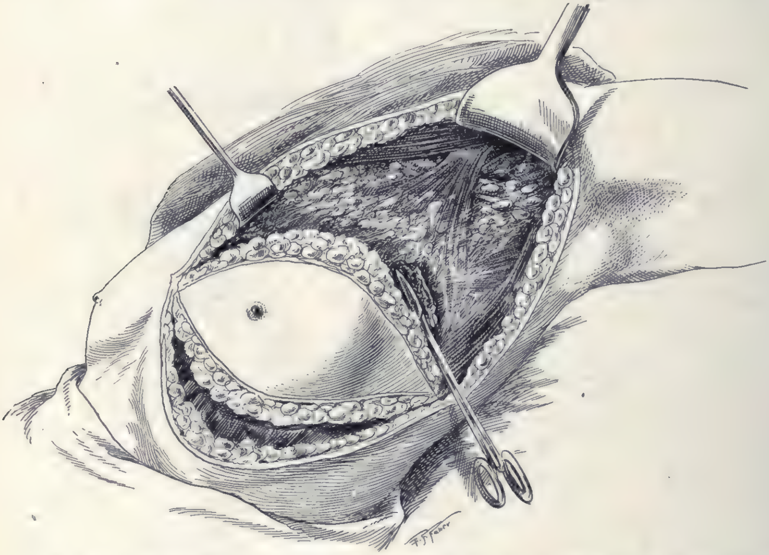


Fig. 80.—Mobilization and retraction of upper skin-flap. The pectoral portion of the pectoralis major has been separated from the clavicular portion and its tendon divided near its insertion.

the latissimus dorsi is removed, and if the glandular involvement is marked, a portion of the sheaths of these muscles. The origin of the pectoral muscles is then divided, but not too close to the ribs, as too close division makes the control of the bleeding more difficult. The breast, with the attached muscles, glands and fat, and fascia, are then turned downward and as much of the sheaths of the rectus and the serratus muscles is removed as is indicated by the extent and situation of the growth. Although it is desirable to remove all the glands and fat with the breast and muscles, one should always go back to the axilla and make sure that none of these tissues have been left. It has not been my custom to remove the supraclavicular glands as a routine except where they are palpably involved or where the growth is situated near the upper periphery of the breast. If the supraclavicular glands are palpably involved my feeling is that we are dealing with a pretty far advanced disease,

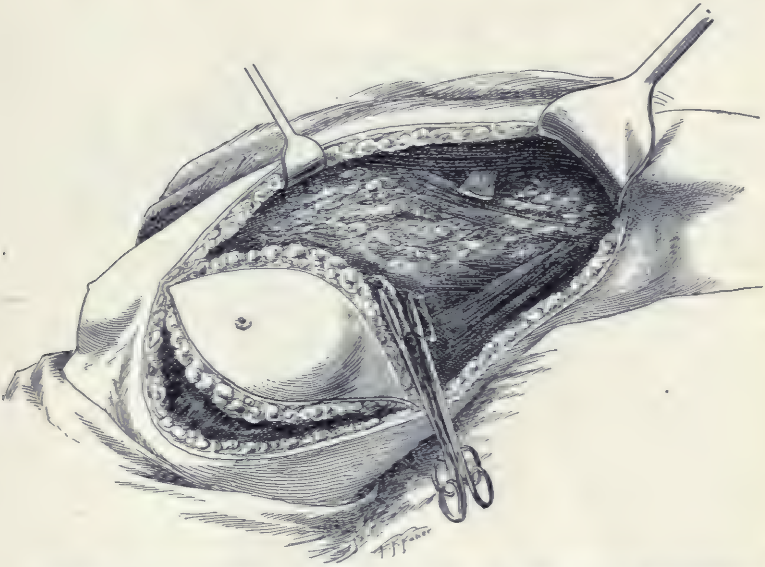


Fig. 81.—The possible retraction of the upper flap and the division of the tendon of the pectoralis minor. The extent of the exposure of the axilla is indicated by the stump of the tendon.

if not one that is inoperable, and in any such case I think that good *x*-ray plates should be made of the chest in order to eliminate as far as possible the question of intrathoracic involvement.

Before closure of the wound hemostasis should be absolute, because one of the most troublesome things after this operation is the accumulation of blood or blood-serum under the flaps. In order to obviate this, in addition to complete hemostasis, a small rubber-covered drain is placed in the axilla and allowed to escape near the outer angle of the wound between two of the stitches, a loop of a silkworm-gut stitch being passed through the drain in order to prevent its slipping out or in. This drain is usually removed at the end of twenty-four hours unless there is an escape of considerable serum, when it is left in for another twenty-four hours. The drain should never be replaced, as continued drainage is very apt to result in infection. If serum continues to accumulate it is better to evacuate it once a day by separating the edges of the wound at the site of the drain.

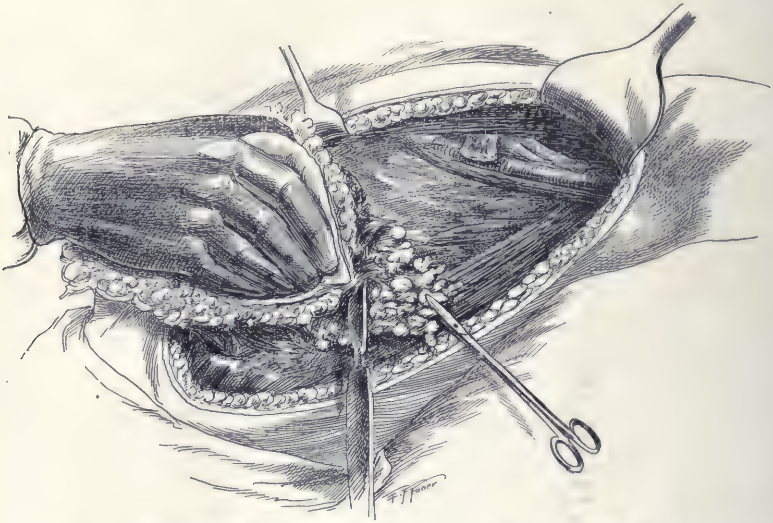


Fig. 82.—The final step of the operation. After the reflexion of the axillary glands and fat, with as much of the sheaths of the subscapularis, the latissimus dorsi, and serratus muscles as is indicated, the attachment of the pectoralis major and minor is divided.

The skin about this opening should be painted with iodin at each dressing to prevent infection from the skin.

One of the serious objections, certainly from the patient's point of view, to many of the incisions employed for amputation of the breast is that the wound cannot be completely closed and that immediate or subsequent skin-grafting is necessary. With the Stewart incision, in more than 90 cases with ample excision of the skin, I have only had to resort to grafting in 2 or 3 cases. In closing this elliptic incision you will observe that the wound is closed from the two ends, that is, one stitch is placed at one end and then at the other, because if the closure is started at one end and carried regularly across the wound one is very apt to find that a slight difference in the length of the two lines of the ellipse will result in a disfiguring inequality in the two edges of the wound. This inequality in the length of the two incisions making the ellipse is often necessary because of the situation of the tumor and the desire to remove the skin widely about it. It can usually be accounted for in closing the wound by including a little more tissue between the stitches on the long side. You will observe that this wound when closed makes a practically straight line across the chest. Before apply-

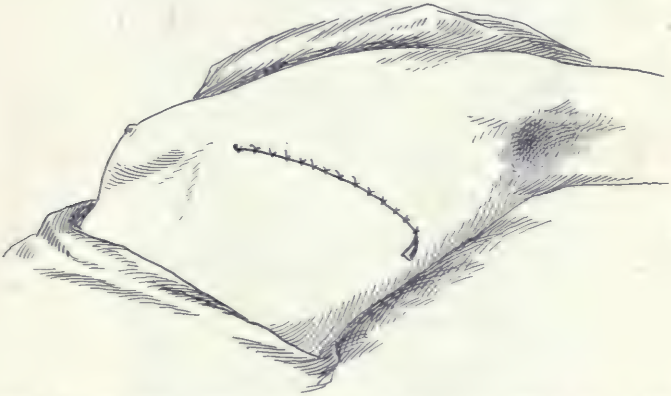


Fig. 83.—The closed wound with small rubber-covered drain. Axillary skin forced back into position, which is easily done when the elbow is raised from the table and the arm is at right angles to the body.

ing the bandage the elbow is elevated and the arm placed at right angles to the body, when it will be possible to force the mobilized skin of the axilla well up and hold it there without difficulty with a gauze dressing. A circular bandage of gauze or a binder is put about the chest and the arm left perfectly free. The patient is encouraged to move the arm, and it is moved for her many times a day. It is a mistake to bind the arm to the side, as it greatly increases the patient's postoperative discomfort, and may result in adhesions which interfere with the subsequent full elevation of the arm. If the arm is not bound to the side, but kept usually at a right angle to the body and the patient encouraged to move it, she can at the end of two weeks put the arm through its normal range of motion. You will observe that the scar of this incision is so placed that a woman is able to wear a modest low neck dress without the

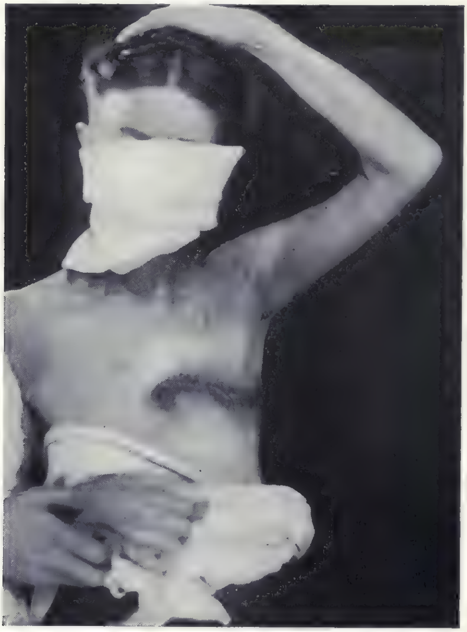


Fig. 84.—Patient has, unassisted, placed her hand on the head ten days after operation.

loss of the breast being suspected or without any part of the scar being visible.

Results.—The immediate results in cancer of the breast are very satisfactory, and due to the thorough operation that is now usually done local recurrences are much rarer than formerly, when too little skin was removed, but too large a proportion of these patients later develop bony or visceral metastases, especially the cases of scirrhous carcinoma. I think one must honestly say that it is impossible to tell when a patient is cured of cancer. I have seen 2 recent cases of recurrence five and a half and six years after the amputation of the breast, and some years ago had a recurrence seven years after the resection of the colon for cancer. These are exceptions, of course. The patient who goes five years after operation with no evidence of recurrence may be considered cured.

I am quite sure that my own results are 25 per cent. better during the past ten years, and I attribute it not to any improvement in the technic, but to the routine use of the *x*-rays after the operation. I am sure that the *x*-rays, too, have much to do with reducing the percentage of local recurrences. I think most surgeons now have come to feel that except in very advanced cancers of the breast local recurrences are not to be expected.

CLINIC OF DR. CHARLES F. NASSAU

Jefferson Hospital

EPITHELIOMA OF THE LIP

Epithelioma of the lip is the most common malignant growth occurring on the face and causes more than 2 per cent. of all deaths from cancer. It is from 17 to 19 times more frequent on the lower lip than on the upper; Loös, in a study of 534 cases, found the proportion 1 : 17; Fricke, 1 : 19; Broders, 1 : 26.

A striking fact in epithelioma of the lip is the preponderance of its occurrence in the male sex. The relative frequency of epithelioma of the lip in the male and female, according to Broders, is 49 : 1. The examination of Continental statistics shows a somewhat higher percentage of epithelioma of the lip in the female, the percentage of its occurrence ranging between 7 and 12 per cent.

There is a wide range of variation in the ages during which epithelioma of the lip develops. A number of cases have been reported in patients twenty-one and twenty-two years of age. It is well to remember, however, that congenital blemishes (nevi, moles, lymphangiomata, epidermoidal rests, adenoma of the mucous glands of the lips, etc.) are prone to occur, in association with which histologic appearances may be met with (ingrowths, pearls, etc.) similar to those seen in epidermoidal cancers; and in some ulcerative processes due to the tubercle bacillus and syphilis somewhat similar appearances may be met with.

A review of almost 3000 cases, as reported by various authorities in the literature, discloses that the average of its occurrence is between the years of fifty-five and sixty; more than one-half of the reported cases develop between the fifth and seventh decades of life, and 95 per cent. of cases occur in patients past middle life.

A family history of malignancy plays a negligible part in its etiology. The disease occurs most often in farmers and other outdoor, or partly outdoor, occupations; 15 to 20 per cent. of the cases are found among those engaging in various indoor occupations. It would seem that outdoor life acts in some unknown manner upon a lesion which orignanlly caused a break of the cutaneous epithelium. A common antecedent history is the presence of a cracked, fissured, or chapped lip, which does not heal. There is similarly a frequent history of a slight trauma which produced a cutaneous epithelial abrasion, for example, the irritation of a jagged tooth. Furthermore, in a number of cases, the occupation of the affected individual was that of a flute player and bugler. The important factors in its genesis are the presence of some lesion or trauma producing a loss of the epithelial covering, and a second factor of some form of chronic irritation.

Paine, director of Cancer Hospital Research Institute, London, is of the opinion that cancer is not a specific disease due to activities of a special parasite, but is a disordered growth of epithelium caused by various chemical or physical irritants, the most important being the toxins of micro-organisms. He considers that the origin of cancer lies in the degeneration of the nobler parts of the cell, consequent on damage of its structure. The result of this damage is to disturb the balance of metabolism by impairing that special function of the cell, thereby causing persistent overgrowth.

The relation of the use and non-use of tobacco to the development of epithelioma of the lip opens up a most interesting study. The high incidence of epithelioma of the lip in farmers has been attributed to their habit of pipe smoking, the latter acting both as a mechanical and chemical irritant, the former by pressure of the pipe, the latter through the heat and combustion products engendered. Yet the history of many cases fails to give a conclusive answer. The percentage of the occurrence of epithelioma of the lip among smokers and non-smokers shows relatively little difference. The latter fact is borne out by statistical studies of Broders, Loös, Worner, Regulski, Fricke, and others.

It is well to state that carcinoma of other parts of the face affects most commonly the male, *e. g.*, carcinoma of the ear shows a preponderance of occurrence in the male in proportions varying from 7 : 2 to 15 : 1, according to different authorities (Trendelenburg, 15 : 1; Gueld, 12 : 1; Loös, 7 : 2; Winiwarter, 6 : 1).

Epithelioma of the lip is often preceded by some lesion which has produced a break in the protective epithelium, *e. g.*, an abrasion, cold sore, crack in the lip, patch of leukoplakia, seborrheic patch, chronic fissure, blister, or a small warty growth. Later induration and thickening begin to develop and sooner or later an ulcer forms. After the ulcer forms it may spread rather rapidly, until a greater or less part of the lip is involved. As the ulcer spreads it eats and destroys the lip, the covering of the chin, may involve the mandible in the process, and not infrequently forms a large, foul, ulcerating mass, involving the lip, floor of the mouth, lymph-nodes, and even the mandible. Death occurs from pain and exhaustion or from hemorrhage. The disease, if not operated upon, lasts from commencement to end, from two to five years. If the jaw is involved the prognosis is bad and it is practically hopeless if the floor of the mouth is involved.

As in the tongue, these precancerous conditions are recognizable and well defined. The importance of their early recognition and treatment cannot be overestimated, for it is these innocent lesions that frequently undergo carcinomatous changes. I am firmly of the opinion that the above precancerous lesions, if they do not respond to mild treatment, should be treated as malignant growths. In this stage they are amenable to treatment and offer a most favorable prognosis. It is the destruction of the epithelium that appears to afford a portal of entry for malignant degeneration.

The reason for early and active surgical intervention in these conditions is all the more urgent since the stage of transition into active malignancy is not easily recognizable by clinical signs.

Induration about the edge and base of the ulcer is of sinister significance. The lowered resistance, especially by previous syphilis, may be an active agent in its development. In the earliest precancerous stages the lesion is local.

Bloodgood states that a wart on the lower lip larger than the end of the index-finger was always microscopically malignant, but smaller warts have been microscopically malignant. The malignant warts are larger than the benign and ulcerate both at the surface and at the base.

Cancerous ulcer of the lip can hardly be mistaken for any other lesion. Chancre of the lip is differentiated by the demonstration of spirochetes from the ulcer, the Wassermann reaction, the acute character of the ulcer, its occurrence at any age, and its response to antisyphilitic treatment.

Some epitheliomata of the lip are active from the start, some grow more malignant with time, others increase in malignancy, and then retrogress. Irritation of a malignant growth adds to its malignancy. Patients who are treated with pastes and plasters, etc., do not get as good results as those who were not so treated.

The growths may be located on either side of the lip, in the middle line, and less commonly at the angles of the mouth.

Epithelial malignancies metastasize or are transferred to other locations by some of the malignant cells becoming separated from the primary growth, and are carried by lymph-vessels to the lymph-nodes, draining the involved area. Occasionally, however, they involve lymph-nodes distant from the affected area. The lymph-nodes act as a temporary barrier to the dissemination of this type of malignant growth. Ewing states "that the invasion of the lymphatics by malignant cells is greatly retarded or suppressed in malignant cases by extensive collection of lymphocytes, which gather in the vessels and may even surround the tumor as a lymphatic ring. Occasionally the entire tumor is infiltrated with lymphocytes, and in such cases the occurrence of many degenerating tumor cells indicates that the lymphoid infiltration is a phenomenon of immunity." Lymphocytes and endothelial leukocytes are practically always seen in the neighborhood of a cancerous growth. The fibrous tissue connective cell is also an important defense cell, since it cuts off nourishment from the cancer cells.

The relation of the lymphatics draining the lip is an important factor in the prognosis and therapy of epithelioma of the lip. The lymphatics of the upper lip and lateral part of the lower lip end in the submaxillary glands. Both the deep and superficial lymph-vessels of the central part of the lower lip run to the submental glands. At times one or more of the lymphatic vessels pass to the deep superior cervical glands. In three-fourths of the cases of epithelioma of the lip glandular metastasis is not demonstrable. The submaxillary lymph-nodes are the most common site of glandular metastasis; less frequently the submental, cervical, and submaxillary salivary glands. The lymphatics of one or both sides may be affected; the latter is more common in epithelioma located in the midline. It is well to remember that the submaxillary and submental nodes may be jointly the seat of malignant metastasis. Epitheliomata located at sides of the lip usually metastasize to the lymphatics of the affected side; metastasis to the unaffected side, however, may take place. Metastasis to other lymph-nodes (parotid, jugular, peritracheobronchial, inferior deep cervical) is not common in primary growths, but usually occurs in advanced cases of the disease and with recurrences. The positive finding of small hard nodes always means a less favorable prognosis.

It should be borne in mind that glandular metastasis may be present in the absence of palpable enlargement. The presence of indurated palpable lymph-nodes means well-advanced malignant disease.

Glandular metastasis may occur within three to six months after the appearance of the primary tumor; it is not uncommon, however, for glandular metastasis to be delayed until nine to twelve months after the appearance of the local growth.

As noted above, palpation does not give an accurate index as to the presence of glandular metastasis. Every glandular enlargement must not be considered carcinomatous. The lymph-nodes may be enlarged as the result of bacterial infection before cancer infection has invaded them. The diagnosis must, in every case, be confirmed by histologic study. A small local growth may give rise to extensive metastasis and vice versa, *i. e.*, a large local growth may exist with but little glandular enlargement. Extensive glandular metastasis is found in cases of recurrence after incomplete removal and with advanced malignancy.

Thiersch has stated that metastasis to the lymph-nodes is due primarily to an involvement of the mandible in the malignant process. This fact, however, has since been shown to be a faulty interpretation. It is my custom to have an *x*-ray of the mandible taken in all cases of epithelioma of the lip.

The type of epithelioma which begins as a vesicle, seborrheic patch, or fissure is usually of slow growth, late to metastasize, and if metastasis does take place it is in easily accessible lymphatics.

The cases in which the malignant disease is so located that one-third or more of the lesion overlaps the mucocutaneous border, even in the absence of palpable glandular involvement, often deceive the surgeon by their rapid metastatic development, within a few weeks or more after the primary growth has been successfully removed. All cases in which one-half or more of the malignant growth encroaches upon the mucous membrane offer an unfavorable prognosis. The prognosis is similarly unfavorable in cases of recurrence and where incomplete operation has been performed. The diagnosis in all cases is confirmed by histologic study.

Broder's studies indicate that the most important factor in squamous-cell epithelioma seems to be the degree of cellular activity. The cells of some epithelioma show a distinct tendency to differentiate, that is, to produce a growth similar to normal. In other squamous epithelioma there is no differentiation whatever; in a majority of the latter type of epithelioma of the lip there are many mitotic figures indicating a high grade of malignancy. Broders has, therefore, divided these epitheliomata into four grades according to differentiation and mitosis, special emphasis being laid on the former. This grading of 1 to 4 is independent of the clinical history. If an epithelioma shows a marked tendency to differentiate, that is, if about three-fourths of its structure is differentiated epithelium and one-fourth undifferentiated, it is Grade 1; if the undifferentiated and differentiated are about equal, it is Grade 2; if the undifferentiated epithelium forms about three-fourths and the differentiated one-fourth of the growth, it is Grade 3; if there is no differentiation of the cells, it is Grade 4.

Broders further states among the known causes of death, deaths from epithelioma were as follows: none of Grade 1; 54.90 per cent. of Grade 2; 84.21 per cent. of Grade 3, and 100 per cent. of Grade 4.

Treatment.—Successful treatment of this curable common form of cancer depends on two things: (1) the earliness with which the lesion is detected; (2) the thoroughness with which it is removed. As noted above, although the lesion may be detected early, within a few months of its onset, and no palpable glands present, if only the growth is removed glandular involvement is a frequent sequel; it is, therefore, urgently indicated in all cases to perform a complete surgical extirpation of the primary growth with all the glands in direct line for metastatic infection. Operation should be performed before metastasis to the lymph-nodes is present. Glandular metastasis always means a less favorable prognosis. Obviously any habit or occupation acting as an irritant to the lower lip must be given up. A lesion or ulcer, as stated above, not responding to mild local treatment after removal of the cause of irritation must receive careful consideration as to operative intervention. Radium and *x*-ray are often curative in these so-called precancerous lesions. When the lesion is clinically suspicious of cancer, radical removal of the growth and the lymph-nodes is urgently indicated and offers the best prognosis.

In the last few years fulguration has been widely used as a means of removing cancer of the lip. In precancerous lesions and in benign growths there is no doubt as to the efficiency of fulguration. I wish to mention the procedure particularly to condemn it absolutely as a routine method in the treatment of malignant growths of the lip. In any epithelioma of the lip that has existed for, say, from three to six months, it is practically certain that the lymph tracts to the submental and submaxillary lymph-nodes are always microscopically infected with cancer, even when not sufficiently enlarged to be palpable. Cancer of the lip is one of the forms of malignancy which, when taken early, is probably curable by operation in 70 per cent. of cases. To merely destroy the growth on the lip is palpably futile. Surgery, and radical surgery alone, gives the best assurance of a cure that we have at our command at present.

Radium will undoubtedly cause the disappearance of epithelioma of the lip, particularly when it does not involve the mucous membrane, but to depend upon radium alone is a procedure open to the same objections that apply to simple destruction by fulguration, or to the excision of the old-fashioned V-shaped piece fron the lower lip.

As an illustration of the inefficiency of treatment by fulguration alone, I wish to present a patient who, in 1915, had an epithelioma of the lip destroyed by fulguration. One year later, in November, 1916, he came to me with not only an extensive recurrence of the growth on the lower lip, but with a mass in the left side of the neck below the angle of the mandible that was clearly visible; on the right side of the neck there was also a mass of large palpable glands. His condition was apparently hopeless. However, at his request, I operated upon him in November, 1916.

I regard the Grant operation as the most useful operative procedure in cancer of the lip. In Grant's operation two vertical incisions are made, one on each side of the growth, and these are connected with a horizontal incision at the base, which is usually about the crease between the chin and lip. Thus a quadrangular gap is formed, which must be filled. An incision is made from the inferior angle of the wound, obliquely downward and backward, on a line midway between the angle of that line and the apex of the chin or symphysis. Its further extension is determined by the amount of lip removed and by the degree of glandular involvement. All the submaxillary glands are removed through these incisions. The removal of the submental glands, in the midline, beneath the chin, may require a separate incision. If the lip is extensively involved the cheek is completely separated from the inferior maxilla to the middle of the masseter muscle. When the glands have been removed the flaps are brought together and united, first of all in the middle line. If the tension is marked, owing to the amount of tissue excised, one mattress suture is inserted, $\frac{3}{4}$ inch from the center line, and tied over pads of gauze covered with oiled muslin to prevent soiling. This removes undue tension from the sutures in the center of the flap. The stitches that unite the cheek posteriorly are now inserted, or, if previously inserted, are tied and the entire thickness of the cheek must be included. Silkworm-gut sutures are used. A small rubber tube should be inserted in the posterior angle of the wound on each side, to drain the mouth and for irrigation purposes. A T-tube the size of a lead pencil should also be inserted through the submental space to the mouth beneath the tip of the tongue (Summers).

The stationary chin tissue is of the greatest importance as a point of fixation for the flaps. When half or more of the lip is removed the operation is completed and perfected by making an incision from each angle of the mouth backward and slightly downward, $\frac{1}{2}$ to 1 inch in length, down to the buccal mucous membrane, which is then separated from the overlying tissues above, below and posteriorly, to the extent of $\frac{1}{2}$ inch. The lip above and below is beveled from the inner border in order to conform to natural conditions and also to make it easier to cover. The mucous membrane is now divided in the middle line and flaps united.

The operation that I do in advanced cases of epithelioma of the lip is that of Grant, as described above, with the exception that the lateral incisions from the inferior angles of the lip incision are curved obliquely downward and backward, well under the mandible and extended as far posterior as is necessary to secure room for the block dissection of the neck. From a point immediately anterior to the facial artery where the latter curves upward over the body of the mandible a perpendicular incision is made down the neck until it meets the anterior border of the sternomastoid muscle, above the clavicle. The skin being well reflected, the entire glandular contents of the neck, from the symphysis of the mandible, as far posterior as the parotid gland, and down to the clavicle, can be removed.

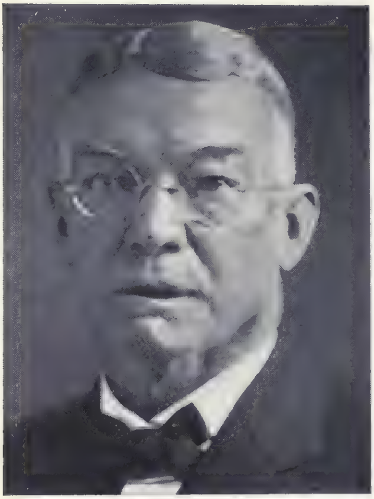


Fig. 85.—The full face appearance of the patient described in text four years after operation for a recurrent epithelioma of the lip with extensive glandular involvement.

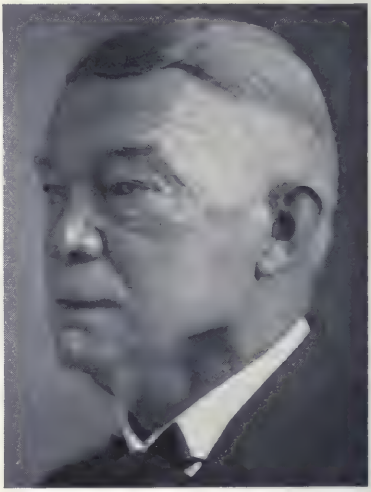


Fig. 86.—Profile view of patient shown in Fig. 85.

In the case of the patient referred to, and whose picture accompanies this article, a portion of the floor of the mouth on the left side was removed, both submaxillary glands, and other structures on both sides of the neck that could be removed by operation without irremediable damage were taken out. A new lower lip was constructed, still following the method of Grant. This patient to date, four years after the above operation, is in a splendid state of physical health.

CLINIC OF DR. T. TURNER THOMAS

UNIVERSITY HOSPITAL

A METHOD OF APPLYING EXTENSION WITH PLASTER CAST FIXATION IN FRACTURES OF THE LEG

OF the American surgeons called to service during the war one will need to search for any not enthusiastically in favor of the Thomas splint and one or other of its associated methods of extension. Not being called into the service, I became responsible for an increased number of fractures and dislocations at home, and, therefore, without the special training and influence from those giving this training in the use of this admirable method of treatment. About three years ago I had the opportunity of observing its application by several competent surgeons, and at that time concluded that it was not as satisfactory as it has since proved itself to be.

Beginning my new work in fractures and dislocations with a distinct fear of infection, non-operative methods were favored, but it was soon evident that for cases with any considerable shortening and, consequently, overlapping of the fragments, the prevailing non-operative methods would not suffice. The test adopted for proving the efficacy of a method of overcoming the overlapping of the fragments was by *x*-rays taken before and after the correction, and this led to an early abandonment of the old Buck's extension for fractures of the shaft of the femur and of the fracture-box for fractures of the leg when there was any considerable overlapping and shortening to be corrected. According to my observations the extension by Buck's method had little or no correcting influence in these cases, while the fracture-box had none at all. The so-called "setting or reduction" of an overlapping fracture of both bones of the leg and maintenance of this reduction by a fracture-box, in my opinion, is almost an impossibility, because the powerful muscles in constant contraction from the irritation of the fragments and traumatic inflammation can be overcome only by a strong pull, and they will immediately reproduce the overlapping as soon as the pull is released.

One of the first methods tried was that of applying strong traction and countertraction by means of a Hawley table, maintaining both by a plaster cast. Although the force applied was sufficient to cause a considerable area of superficial necrosis on the dorsum of the foot by the time the cast was removed, in about a week, it produced no appreciable effect in overcoming the overlapping of the fragments. The fracture was then plated. In another case, a young man with some atrophy of the limb from infantile paralysis and very little fracture deformity, the traction applied had no correcting effect on the slight overlapping fragments, but the cast was not removed for eight weeks, when union was firm. The method was discarded.

Having some time before the war conceived the germ of a method and having tried it in various forms with partial success the increased clinical material led soon to the development of a plaster cast method of applying traction and fixation, especially to fractures of the leg, and with less satisfaction to those of the thigh. A modification of the principle was tried in forearm fractures, but with less satisfaction than in those of the femur. The traction was applied at one sitting under a general anesthetic, preferably ether. It has the great objection common to all non-operative methods which depend upon traction and countertraction. The degree of force necessary to overcome the contraction of the powerful muscles upon which the shortening and overlapping of the fragments depend is so great that the patient frequently complains. The Thomas splint originally depended on the Buck adhesive plaster method with the Spanish windlass principle for regulating the degree of traction. The popularity of the ice-tongs traction is due to its more direct and effective pull on the lower fragment, while the continued use of the Buck extension and Spanish windlass and the introduction of the Sinclair skate and the continued use of other methods of applying the traction to the foot indicate that no one of these methods enjoys general approval. As already stated, the powerful muscle contraction requires too much traction by any method for the comfort of the patient.

In the method here proposed the traction is applied to the foot by means of a plaster cast as has been done many times before, and as has been already discovered the foot will not easily tolerate the traction sufficient to overcome the deformity. My effort has been to remove the portions of the cast immediately overlying the points of greatest pressure, thus compelling the remaining upper surface of the foot heavily padded with cotton to have the extending force generally distributed to it. The accompanying *x*-ray evidence will show a fair if not good degree of correction of the deformity in the various fractures illustrated. It is, of course, generally less than that obtainable by operation.

Two parts are distinctly essential and peculiar to the method, an ordinary wooden splint and a metal piece (iron has been used), which serves as a lever and fulcrum for the application of traction. For leg fractures the splint should be about 4 inches wide, 1 inch thick, and long enough to extend from 2 or 3 inches above the knee to about 18 inches below the foot. It is made as thick as an inch that it may stand the strain to which it is to be put later, and about 4 inches wide, so that it may receive the weight of the limb comfortably and at the same time be narrow enough to permit the plaster cast to surround the limb snugly and take advantage of any bony prominences at the knee and ankle for the application of traction and countertraction. The excess of 18 inches below is to permit it to allow for the effect of the extension on the fracture during the application of which the splint is forced upward toward the trunk more than one would at first be inclined to expect. When the necessary extension has been obtained any useless length of the splint below can be sawed off.

The iron plate is the key to the whole method. Its purpose is to fix the leg in extension and if necessary increase the extension during the application of that part of the cast which is to maintain the traction afterward and immobilize the fracture. It should be about 2 inches wide, 12 inches long, and $\frac{1}{4}$ inch thick. Its lower end is extended into a point which serves to catch firmly in the wooden splint and act as a fulcrum for maintaining the traction while the fixing portion of the cast is being applied. This point has been made about $\frac{3}{4}$ inch long and about as wide where it becomes continuous with the body of the plate. It should be beveled to the point on one side. This will permit it to take a firmer hold of the splint if the plane surface is turned upward and the beveled surface downward toward the lower end of the splint.

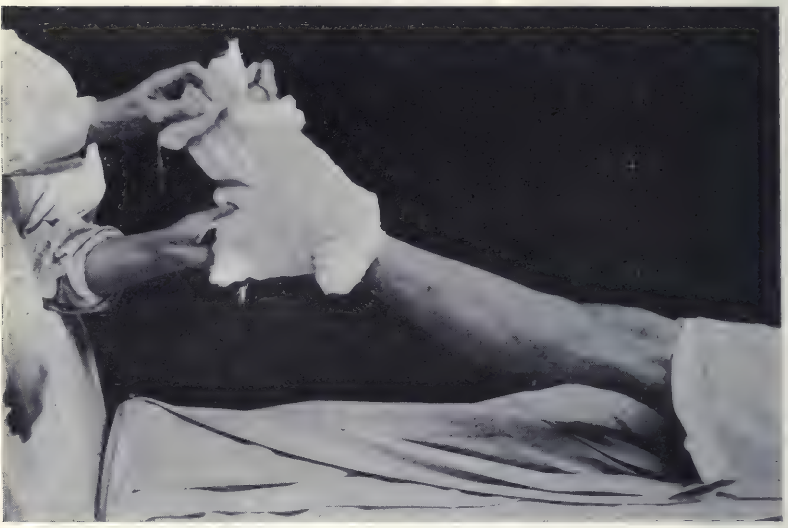


Fig. 87.—Application of the plaster cast of the foot which is to hold the metal plate. Note the heavy padding with cotton, especially on the dorsum of the foot and above the heel. Note also that the cast will permit motion at the ankle.

This iron plate is first applied to the plantar surface of the foot, as shown in Fig. 87, with a thin layer of cotton between it and the foot and a similar thin layer of cotton on the outside of the plate, so that it can easily be removed after the whole cast has been satisfactorily applied and has hardened. A layer of cotton about 3 or 4 inches thick is then wrapped around so as to cover especially the upper surface of the dorsum of the foot and heel, the two ends of the layer being made to cross each other on the dorsum to give additional protection there where most of the traction pressure will be felt. Holes are to be cut later here and under the upper surface of the heel and the cotton picked out until the undue pressure is relieved. A few turns of a plaster bandage are now used to encase the foot and plate, making the turns snug enough to prevent this portion of the cast from being pulled over the heel by the traction to be applied to it later and the cast strong enough to stand the strain. The foot should be held at right angles to the leg while the plaster is being applied, and the upper edge of the cast should have a generous layer of cotton between it and the skin to prevent the cutting of this edge of the cast into the skin when the traction is being applied.

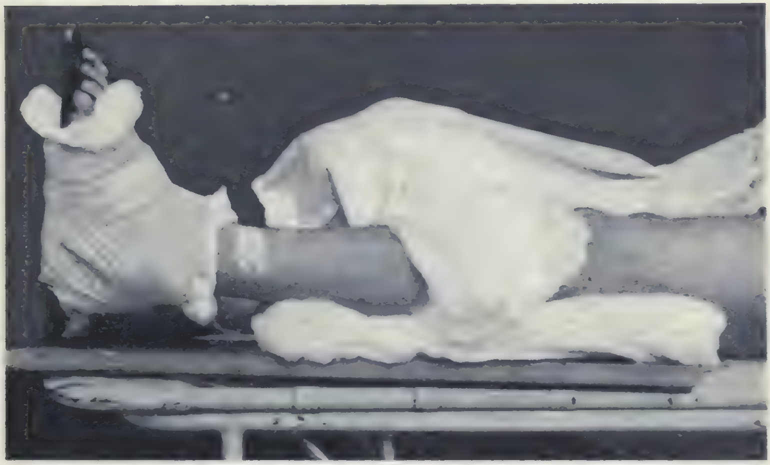


Fig. 88.—The splint, heavily padded with cotton, is placed under the limb with its upper end just above the knee-joint and the lower end projecting below the foot. A thick layer of cotton is placed in front of the lower part of the knee where the counterpressure will be most felt. The splint and limb from well above the upper end of the splint to the lower end of the cotton placed in front of the knee will be covered by a flannel bandage in preparation for the plaster covering shown in Fig. 89.

The wooden splint is now covered by a layer of cotton 5 or

6 inches thick which will be compressed by the leg as shown in Fig. 88. When the leg is placed on the splint the upper edge of the latter should extend 2 or 3 inches above the knee. Extra cotton should be employed to make up for the diminishing diameter of the lower part of the calf of the leg. A generous layer of cotton should be placed also over the lower part of the knee as shown in Fig. 88 where the counterpressure will be most felt. A flannel bandage is then used to cover the limb

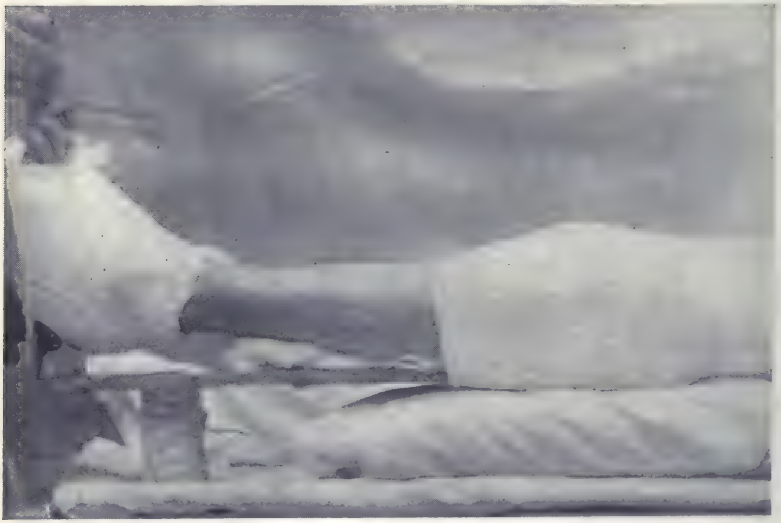


Fig. 89.—Shows the two disconnected segments of the cast in position, hardened, and the extension being applied. The two hands of the surgeon are seen grasping the metal plate above and below the foot and applying the traction, the countertraction being effected by the pressure of his knee against the lower end of the splint which has been eliminated from the picture.

and splint from 5 or 6 inches above the upper end of the splint to the lower part of the knee or about where it joins the calf as indicated in Fig. 89, where it is shown covered by a substantial thickness of plaster cast. It now becomes necessary to wait until the plaster material hardens, usually until the following day, and as the foot has not yet been fixed to the wooden splint it must be supported and prevented from falling to one side or the other. A sand-bag on each side and both tied to the leg or a fracture-box pushed upward under the splint as far as it will go and the sides of the box properly padded and tied together, will suffice.

When the plaster cast is sufficiently hardened to stand the strain and the patient is anesthetized, preferably by ether, the traction is applied and the cast completed. The most responsible part of the procedure is the determination and application of the necessary degree of traction. This responsibility belongs to the surgeon in charge of the case. He will be surprised to learn how much traction can be applied in an ordinary overlapping fracture of the leg without overcoming the overlapping entirely. He will learn too that traction alone will not usually place the fractured surfaces in apposition, and that in some cases in which there is an excessive tendency of the lower part of the leg to curve inward the lateral displacement will be increased by the traction. With the end of the splint extending below the end of the table and the splint resting on the table directly, not as in Fig. 89, during the photographing of which it was elevated for illustrative purposes, the surgeon grasps the iron plate above and below the foot as shown in Fig. 89, places his knee against the lower end of the splint and makes what he believes is enough traction to overcome the overlapping and holds it by sinking the end of the metal piece into the wooden splint, fixing it more firmly by driving the point of the metal into the wood by a hammer or anything which answers the purpose. If he inclines the iron plate so that the point is directed toward the lower end of the splint as much as possible and the opposite end directed toward the knee, he may add further traction when the point is fixed in the splint by pulling downward on the upper end of the splint as far as he thinks it justifiable (see Fig. 90). The degree of traction applied will depend upon the personal equation, as well as upon the resistance offered by the contracted muscles.

When the proper traction has been applied it is held by the metal piece until the rest of the cast is on and hardened, when the traction will have been transferred to the cast. The best method of completing the cast can hardly be said to have been established. Figure 91 shows the metal piece maintaining the traction while the cast is being completed. My present procedure is to first cover the leg and splint by a flannel bandage in the interval in which the leg is bare down to the end of the cotton padding, or to within 6 or 8 inches of the ankle; and then apply the plaster connection between the two previously disconnected casts, beginning below the knee and including the leg and splint as far down as the end of the cotton padding between the leg and splint. From this point down the flannel bandage was made to pass between the leg and splint and the plaster bandage likewise as shown in Fig. 91. This will give a more direct and

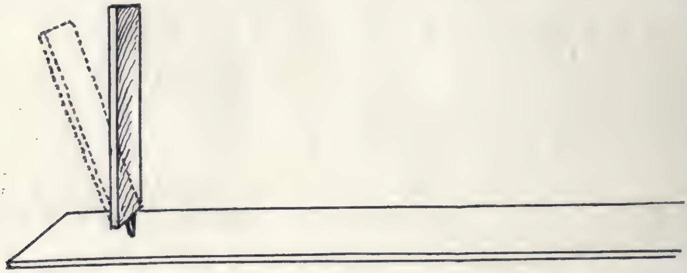


Fig. 90.—When the desired traction has been applied the pointed lower end of the metal plate is driven into the splint for fixation. Further traction may still be applied by pulling downward on the upper end of the plate as indicated in this illustration. It may be an advantage to incline the plate so that its point is nearer the lower end of the splint when the traction on the upper end of the plate will bring the foot to a right angle with the leg for fixation by the cast.

solid continuity between the two previously separated parts of the cast and later will permit removal of the part covering the upper surface of the heel without losing much of the traction on the foot. After this has been done the plaster bandages are passed around the ankle, foot, and leg above and the splint below without any effort to pass them between the limb and splint. If one is not careful he will find later that in applying this part of the cast he has forced the heel uncomfortably close to the splint and the patient will complain of a pain or burning of the heel due to pressure of the heel on the splint. It may compel removal of the cast. If it is only slight, a piece of muslin bandage passed under the heel and tied to a stand of some kind placed over it, as for keeping off the weight of the bedclothes,

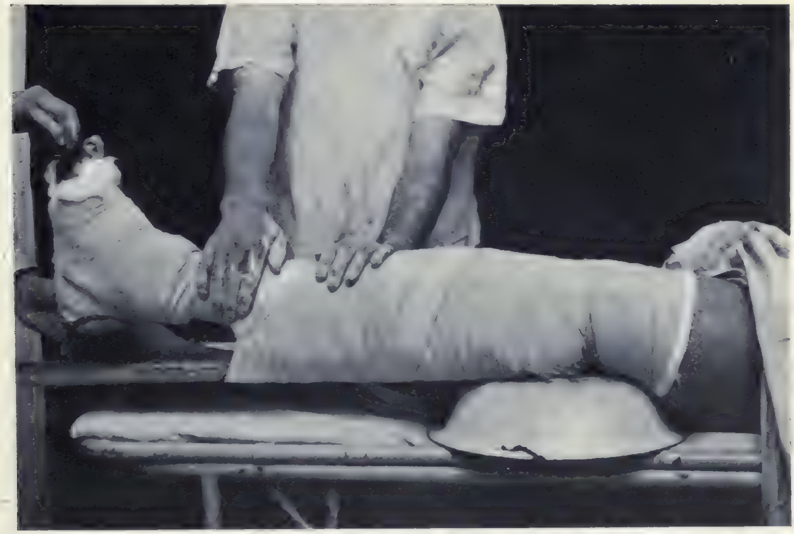


Fig. 91.—The traction has been applied, the point of the metal plate has been caught in the splint and hammered down for better fixation, and the connecting portion of the cast is being applied. The bare portion of the leg including the seat of fracture has been covered by a flannel bandage and this by plaster material. Note that the plaster surrounds the leg and splint to within 6 or 8 inches of the ankle and from this point down encloses the limb only, including enough of the foot and knee casts to make a good connection between these two previously disconnected portions of the cast. This plaster connection plays a very important part in maintaining the extension when the pull on the metal plate is released. Note the mark made by pen and ink under the heel. This indicates the portion of the cast to be removed later for relief of pressure on the heel, and is shown here because it will be covered in the finished cast. The hands of the surgeon have been so placed here, correcting a lateral displacement of the fragments, to emphasize the importance of correcting any displacement at this stage during the extension. The *x*-ray will show the direction in which to make the pressure and it should be borne in mind that too much pressure can hardly be made. Undercorrection is more likely to take place.

will lift the heel from the splint enough to give the needed relief. The surgeon will determine for himself how to apply this last portion of the cast so that it will be strong enough to take the strain of the traction from the metal piece which can afterward be removed. I have no definite way of applying the turns of the plaster bandage, but keep in mind what it is necessary to accomplish, and apply the turns successively until the object is accomplished, which is determined when the cast has sufficiently hardened and takes the strain when traction on the metal piece is released.

Figure 92 shows an opening in the cast over the dorsum of the foot about 3 inches long and 1½ inches wide made to relieve pressure here where it is likely to do the most damage and give most distress if it is not relieved. It will usually be found, if the extension has been severe enough to overcome the overlapping of the fragments, that the skin is bloodless when exposed through such an opening. By picking away the cotton and lifting the still soft margins of the opening in the plaster this pressure should be gradually lessened until the skin becomes pink or red, showing a good circulation. Otherwise there will

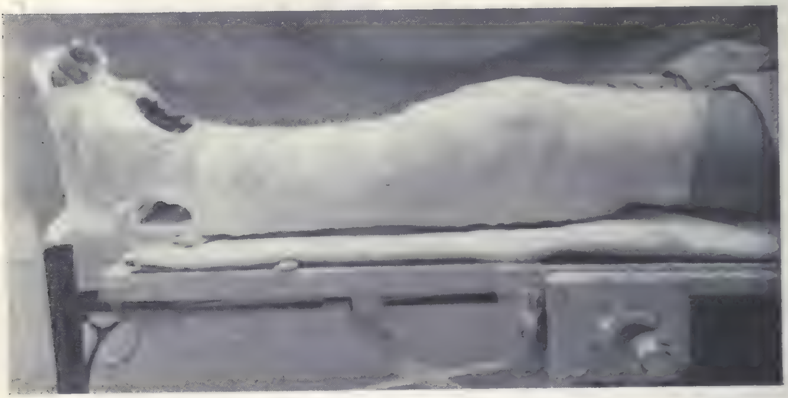


Fig. 92.—Shows the finished cast with opening for the release of pressure where it does most harm. On the opposite side is an opening similar to the lateral one shown and both were made to facilitate the removal of the portion of the cast under the heel and marked in Fig. 91. In completing the cast the purpose is to so apply the bandage that it will hold the foot in the position fixed by the metal plate. The excess of splint below has been removed. The traction is maintained by the metal plate until the cast is hard enough to take the strain without making any creasing or cracking in the cast.

likely be sloughing here later. On the side and near the splint can be seen another opening of about the same size through which the plaster covering the upper surface of the heel was cut away while it was still soft and before the pressure here has time to do permanent damage. A similar opening is made on the opposite side in the corresponding situation to aid in making the deeper opening above the heel. The outline of one side of such an opening was marked with a pen on the cast shown in Fig. 91. Cotton may be picked away here also until one is satisfied that this portion of the heel is relieved of pressure. When the patient recovers from the effects of the ether he may complain and compel still further relief of pressure. It is not claimed that this will prove to be an easy, safe, and always successful method of treating these troublesome fractures, but one that will require care in the application and much study to avoid errors. There would be no particular difficulty in applying sufficient traction and manipulation to obtain a good reduction of the deformity in most cases if we could ignore the effects of the traction on the foot. That it can accomplish fairly good reduction the accompanying illustrations show, and it can be said that the complaints of pain and distress can be largely overcome by attention to the above methods of relieving pressure.

War experience proved, perhaps more than anything else in surgery, the value of extension in fractures of the long bones. The successive devices employed for the application of the extension proved that there were difficulties associated with it. My own feeling is that we are not quite ready for a standardized method of treatment, although we have come nearer to an efficient standard in the Thomas method than we have ever come before. The method with Buck's extension and sandbags or other lateral splinting came close to being a standard method for years, but would not now be considered an efficient one. I feel also that the open reduction and direct fixation of the fragments is only temporarily in eclipse. From the extreme conservatism of the Buck and similar methods the pendulum swung to the extreme in the opposite direction, *i. e.*, to open reduction and direct fixation of the fragments. It has of late gone back to the conservative side, but not quite as far as at first. We are taking somewhat more risk with the ice-tongs and giving more discomfort by the greater pull of the newer methods of extension. I believe it will swing over to the operative side again, but not go as far as on the first swing. The operative treatment has not yet become obsolete. The great advantage of the non-operative treatment is avoidance of infection, but it probably never will give as good anatomic results as the operative method. The functional result will depend more upon the anatomic result than upon any other factor.

Discontent in my early efforts with the anatomic results of non-operative methods led to a trial of the open method. They were so good that the temptation was to increase the number of operations. Then came a supracondyloid T-fracture of the femur with some additional comminution in which non-operative methods failed to accomplish any correction of the deformity, and operation was done through two incisions, one over the internal and the other over the external condyle. Failing to adjust satisfactorily the internal condylar fragment which was attacked first, the external incision was made and the external fragment was adjusted with difficulty and plated, but when the internal wound was again exposed the internal condylar fragment was seen protruding from the wound and almost completely detached. Replacement and adjustment of this fragment was found impossible, and it was removed. Both wounds were closed without drainage and a dressing and plaster cast were applied. No signs of infection occurred and the cast was not removed for seven weeks, when a small sinus was found with a slight discharge. It is my present belief that this merely indicated that not enough time had elapsed for the complete filling in by granulation tissue of the cavity left by the removal of the big condylar fragment, and that removal of the cast and dressings led to infection. Long-continued efforts to close the sinus failed, the fragments and joint became infiltrated with pus, and finally amputation above the knee was done. A few months later, in August, 1919, a chronic alcoholic, nearly fifty years of age, jumped from a second-story window while intoxicated, and sustained a comminuted fracture of the upper third of the femur, including fractures of greater and lesser trochanters. The adjustment of the fragments by open operation proved difficult and prolonged. Infection followed and the patient died in about a week.

These 2 cases almost decided me against the open method, at least for nearly all cases, but my whole experience for the preceding year, with the exception of these cases, had been so good that it was concluded to try again, and to exclude particularly comminuted fractures of the femur and patients of suspiciously poor nutrition. My records for the past twenty-six months show 34 fractured femurs operated on and 4 fractures of the neck of the femur, in which wood screws were passed through the fragments. In every case the wound was swabbed thoroughly with dichloramin-T just before closing and a plaster cast applied from the pelvis to the foot, always including the pelvis and usually the foot. In 2 cases a second operation was done for a broken Sherman vanadium steel plate. I did the second operation in one case and both in the other. In a third case a second operation was done for bending of the bone after weight bearing was allowed, the Parham-Martin bands having been employed. Except in the two in which the broken plates were removed and the third, in which the bands were taken out, in not one (barring, of course, the 2 cases referred to above) was a cast removed until union was considered complete or the wound reopened for any purpose. In not one was there any sign of infection, not even stitch infection. It has not been possible to make in the available time a satisfactory examination of the records for other fractures operated on. There were probably close to as many operations done on all other fractures as were done for fractured femurs, but except in one case of fracture of both bones of the leg there was not as much as one stitch infection, and in no other case was a plate or any other fixation material removed. In the one fracture of the leg mentioned, because of the absence of signs of infection the plaster cast was not removed for six weeks, when a small sinus was discovered with slight discharge, on account of which the plate and screws were removed and the wound left open for healing. Union had not occurred, but the fragments were in excellent position and united later with a practically perfect result. Such results should, in my opinion, influence one in favor of further trial and not of discarding operation.

In all of the cases here illustrated by x-ray plates, except in one femur fracture (Plate III, Fig. 5) and one leg fracture (Plate IV, Fig. 11), the method of extension with plaster cast fixation was employed. The particular manner of employing the method in fractures of the femur has not been offered because neither the method of application nor the results were considered sufficiently satisfactory. The difference in results is evident in the illustrations. One reason for the difference is as follows: Traction alone did not seem to bring the fragments into sufficiently good alinement, so that direct pressure on the fragments was employed. While the traction was being applied and before the region of the fracture was covered with the plaster, and while it was being covered very vigorous pressure was applied by the hands (as shown in Fig. 91) on each fragment in the direction necessary for correction of the deformity as shown by the x-ray. Overcorrection in fractures of the leg seemed to be impossible regardless of the degree of corrective force applied. This did not apply with the same force in the fractures of the middle of the shaft, but seemed to apply to the supracondyloid fractures as shown in Figs. 87, 88. My present inclination is to favor this method for the non-operative correction of fractures of the shafts of the tibia with or without fracture of the fibula, and the Thomas splint and ice-tongs traction for the femur fractures, although I have a strong inclination toward the open method for clean-cut simple fractures in healthy young persons, particularly for fractures of the femur. There has gradually developed in the past two years and a half a confidence in the operative technic and the avoidance of infection not unlike that which most of us feel concerning the danger of infection following operation on a clean case of appendicitis. It may prove later that this feeling of confidence is not justified, but so long as it lasts one is justified in trying to prove that it is justified.

COMMENT ON CASES ILLUSTRATED BY SKIAGRAPHS

Plate III, Fig. 1: Severe traction was necessary to obtain the degree of correction shown here which was considered sufficient to render operation unjustifiable. Some separation of the fragments and, consequently, lengthening of the limb is evident here. Only perfect approximation of the fragments could prevent some lengthening.

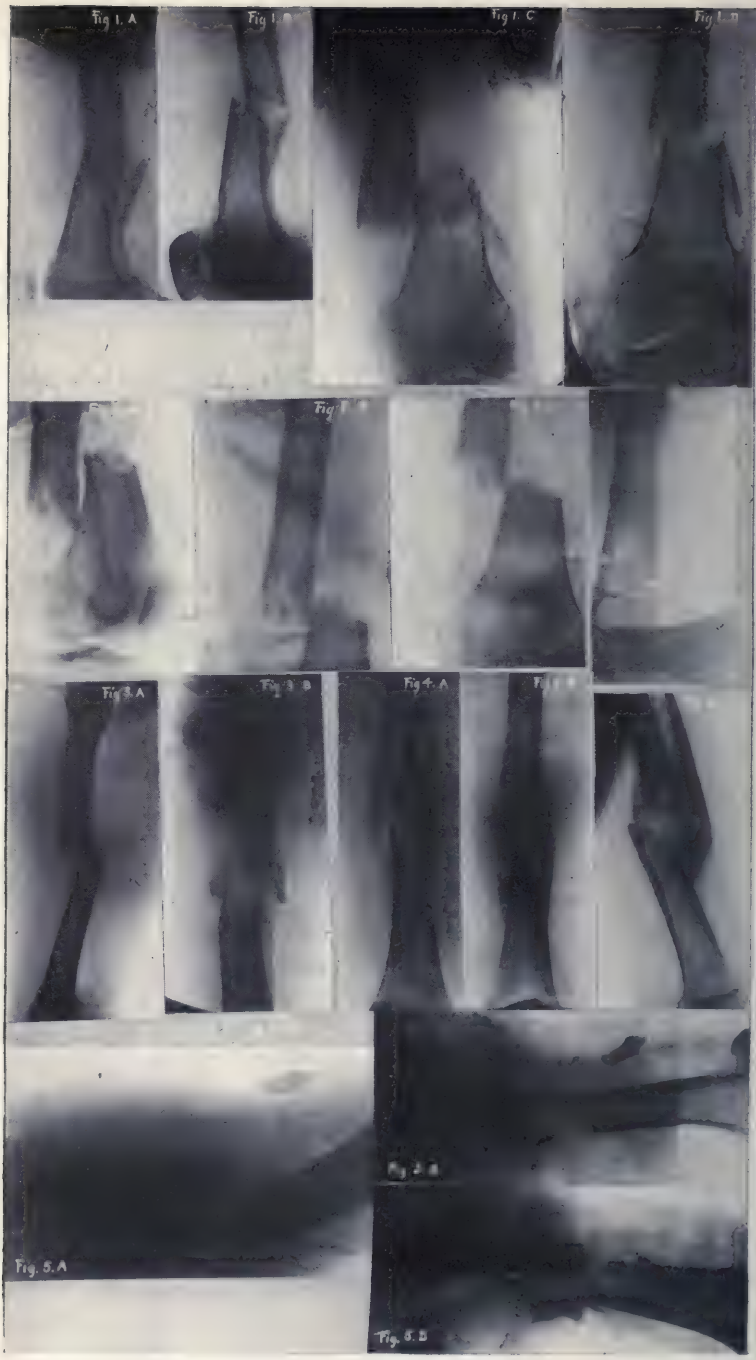
Plate III, Fig. 2: The successive pictures in this case are all anteroposterior views. The lateral views showed little deformity and were eliminated. *A* shows the original deformity before the correction. *B*, After first attempt at correction. *C*, After second attempt. After each of these two attempts the limb at the site of fracture was not enclosed in the cast, so that vigorous manipulation could be made in the efforts to correct the displacement. Repeated attempts were fruitless, nor could the deformity be detected by palpation owing to the tension on and consequent rigidity of the overlying muscles. A comparison of the corresponding portions of both fragments will show that normal length was obtained in the first attempt and slight overlengthening in the second. Therefore it is not right to assume correction of the displacement because the shortening has been nearly or quite overcome. *D* shows correction by open method.

Plate III, Fig. 3: Anteroposterior views alone showed displacement, and consequently the correcting influence of the traction and manipulation of the fragments. *A*, Before and *B*, after correction, or rather, overcorrection. Strong union was obtained and excellent alinement of the whole limb. The fracture occurred in June, 1920. Measurement of the two limbs in November showed slightly more than $\frac{1}{4}$ inch lengthening of the affected limb.

Plate III, Fig. 4: Such comminution makes operative fixation difficult and infirm. The fracture occured in March, 1920. The union is firm and the alinement of the whole limb excellent. Measurements of both limbs recently showed $\frac{1}{4}$-inch lengthening of the affected limb.

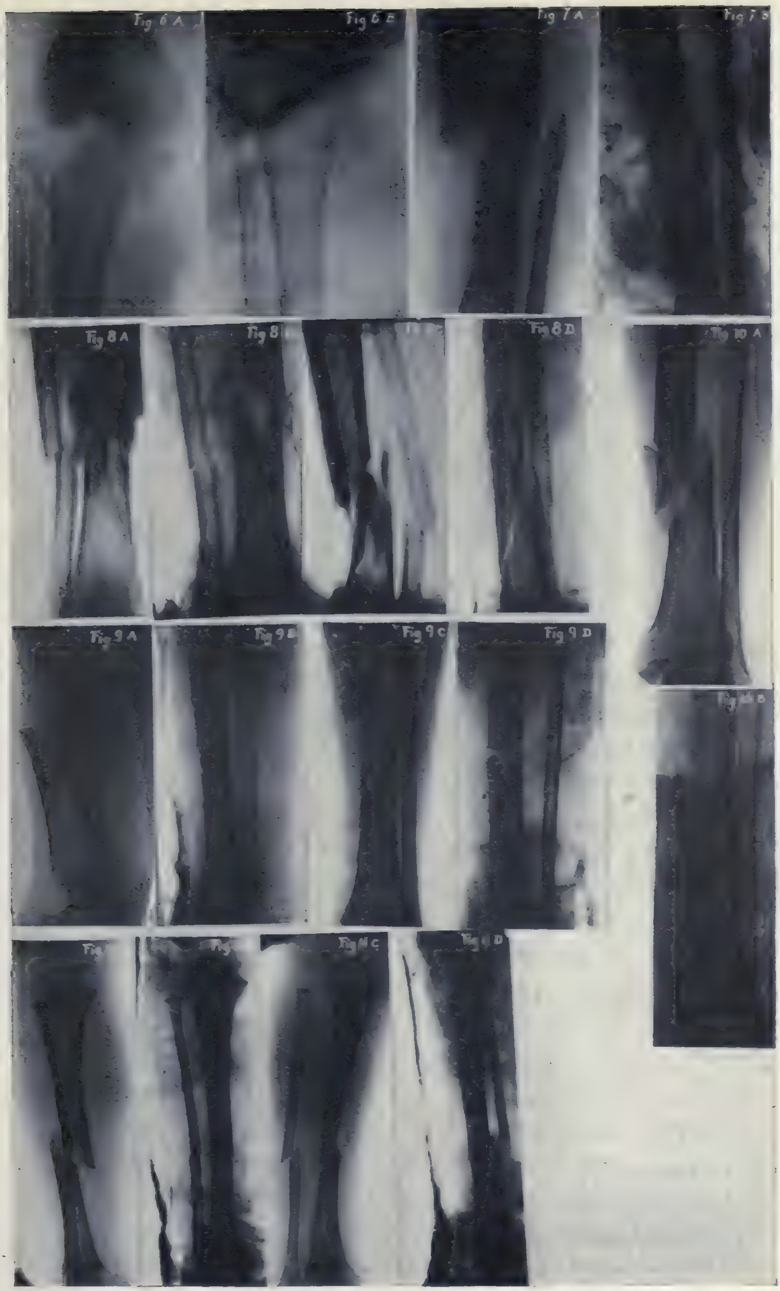
Plate III, Fig. 5: In this case the Thomas splint and ice-tongs traction were employed two weeks after the fracture occurred. The correction was accomplished in from two to three weeks, but eight weeks after beginning this treatment union had not occurred. Because of the period at which the extension was applied a longer time for union will be necessary. *A* shows anteroposterior view before correction; *D*, after correction; *C*

PLATE III



x-Ray pictures of fractures of thigh.

PLATE IV



x-Ray pictures of fractures of leg.

shows lateral view after correction. The corresponding view taken before traction was applied did not include the seat of fracture.

Plate IV, Fig. 6: This patient was a very heavy woman, and the problem of obtaining in such a case a good anatomic and functional result presented special difficulties, Ten weeks after the accident she is beginning to take the weight on that limb and the prospects seem good.

Plate IV, Fig. 7: Only the anteroposterior views are shown because the lateral views show good alinement of the fragments and little deformity. Consequently they would not show the correction. The same is true of Plate IV, Fig. 10. *A*, Before and *B*, after correction.

Plate IV, Fig. 8: *A* and *B*, Anteroposterior views before and after; *C* and *D*, lateral views before and after correction.

Plate IV, Fig. 9: Fractures as transverse and irregular as this one are difficult of correction because they call for a considerable overcorrection of the shortening to permit the irregularities of each fragment to pass each other for complete adjustment. The *C* plate shows less overlapping than the *A* plate, which was one of those taken before any attempt at correction, because the *C* plate was taken after an attempt at correction and after some of the overlapping had been overcome, the original lateral view having become mislaid.

Plate IV, Fig. 10: No fracture of the fibula is shown in these plates. This, however, does not completely exclude such a fracture, as it might have occurred above the highest part of the fibula shown in the plate.

Plate IV, Fig. 11: This child was about four years old, too young for ice-tongs and rather too young for the extension cast method, which requires some toleration of discomfort in the early stages following its application. The degree of deformity was enough to call for correction, so that an incision was made to the fracture, with as little disturbance of the tissues as possible, the fragments were adjusted, grasped with a pair of bone forceps, and a small nail driven through both to prevent the muscles from reproducing the deformity. The particular difficulty with this method was connected with driving the nail in the right direction and selecting a nail that was not too long or too short.

CLINIC OF DR. JOHN H. JOPSON

PRESBYTERIAN HOSPITAL

OLD FRACTURE OF THE PATELLA. TREATMENT BY OPEN OPERATION, WIRING OF THE FRAGMENTS, AND SUTURE OF THE FASCIA AND APONEUROSIS

THIS patient, an active, heavily built man thirty-eight years of age, received severe injuries in a motor accident in April, 1920, sustaining fractures of the sternum, ribs, and right patella. He was treated in another hospital, and no operation was performed for the fractured patella, but splinting and later the application of plaster casts was resorted to. He now presents himself, five months after the accident, with non-union of the patellar fragments and a practical disability of the limb. On examination, he is observed to walk with a well-marked limp, and uses a cane at all times. He has complete loss of the power of extension of the knee, can only swing it forward, and cannot balance himself on the affected limb. The two large fragments are freely movable and can be approximated by pressure when the limb is extended (Fig. 93, 1). When the knee is flexed they are separated by a distance of 2 inches, and the condyles of the femur can be palpated between them. There is evidently only a thin layer of fascia connecting them, which is too wide and attenuated to transmit any extensor action to the lower fragment or lend any stability to the limb. In view of the disability which prevents him from pursuing his vocation of a traveling salesman, his comparative youth, and good physical condition, an operation is strongly indicated.

The operation which we prefer in these cases is similar to that which is employed by us in recent cases of fracture of the patella, with such modifications as are necessary to secure apposition of the freshened fragments, where they cannot be approximated easily by reason of contraction of the quadriceps muscle, as in injuries of long standing. The opportunity to employ it is seldom offered at the present time, when the great majority of recent fractures of this bone are subjected to early operation, with the most gratifying results. For example, of about 30 fractures of the patella operated by us in civil life, only 1 was an example of non-union, and this was of about two years' standing. One was a case of compound fracture, the remainder were simple recent fractures. During this same period a few cases of patellar fracture were seen and treated in which operation was not indicated, by reason of the fact that they were examples of simple fracture the result of direct violence, without tear of the aponeurotic covering and lateral expansions, and without consequent separation of the fragments. Such cases in our experience heal readily, and with strong and bony union, by fixation alone. The great majority of fractures of this bone are the result of indirect violence, sustained in falling, and with few exceptions call for operative intervention. The safety of this is shown in our series, which was without mortality and without joint infection. In 2 or 3 cases there was a limited superficial infection of the subcutaneous fat.

In this case we make the usual curved incision downward (Fig. 93, 2), and the flap so formed is lifted with forceps, exposing the fragments connected by a broad thin sheet of fascia. We proceed with the usual technic employed in joint and bone cases, avoiding the introduction of the gloved hand in the wound, and using the forceps technic for sponging and handling of the tissues as far as is practicable. The fascial covering is divided, but not resected, being spared to assist in the reconstruction of the covering ligaments. The fractured surfaces of the patellar fragments, covered with connective tissue, are exposed (Fig. 93, 3). This covering is resected with sharp scissors, and the condensed underlying bony surface further cut away with bone forceps, thus vivifying the areas to be united. Approximation of the fragments in this instance is easy. In a former case of non-union, operated after a much longer interval, and in a patient

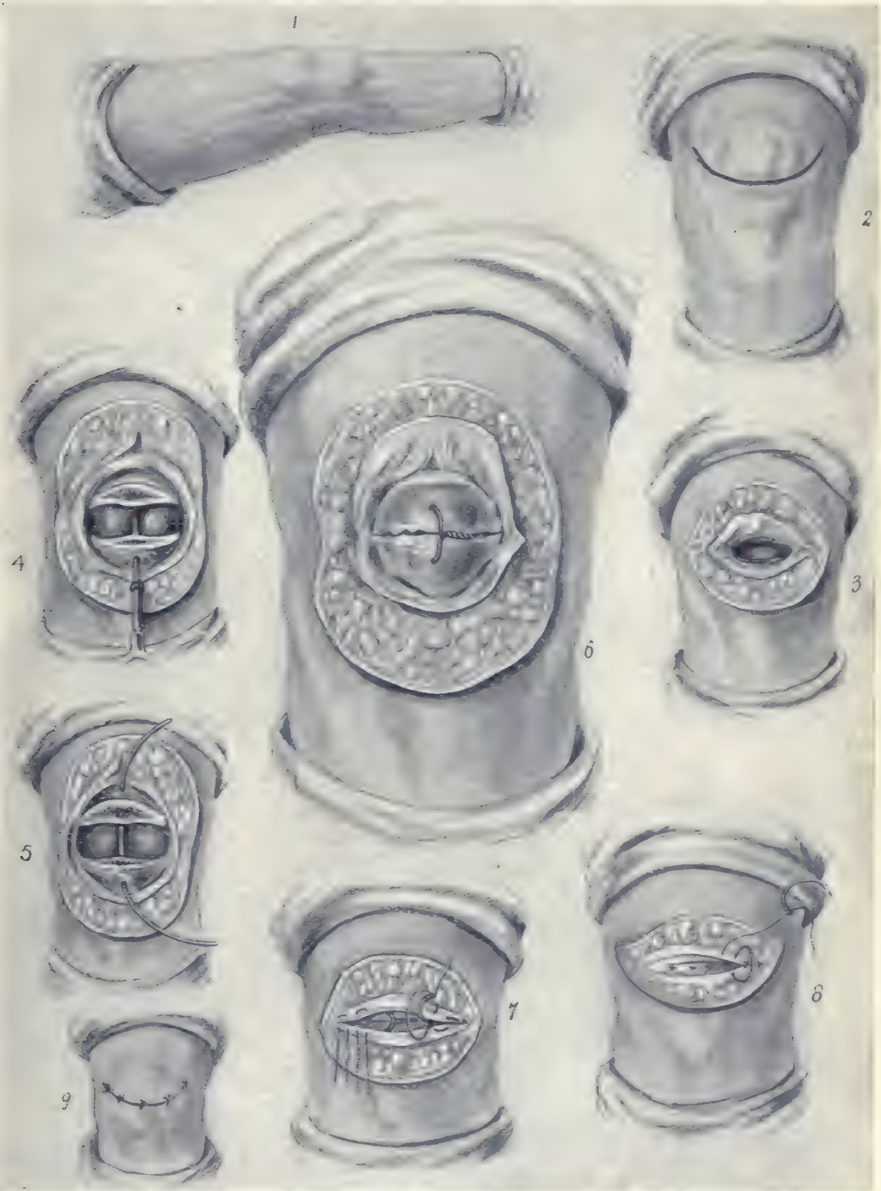


Fig. 93.—Old ununited fracture of the patella. Operation, wiring, and suture.

who had suffered repeated traumatisms, the fragments could not be brought together at this stage. In that instance we first did a plastic lengthening of the quadriceps tendon, and shortened by a considerable distance the gap separating them, but still they could not be apposed. We then proceeded to a subperiosteal resection and elevation of the tibial tubercle after the plan of von Bergmann, nailing it to the tibia at a higher level, after which the lower fragment could be attached to the upper one. In that case we achieved a very satisfactory result. In this patient we need no such technic, but proceed to drill and wire the fragments prepared by freshening. We still stress the use of silver wire fixation even in recent patellar fractures. By its use we believe we maintain a more secure fixation and approximation of the broken surfaces immediately, and for a longer period during the process of repair, than by the more popular technic of suture of fascia and aponeurosis alone. Furthermore, we have less hesitation in removing the splint early and encouraging the patient in the active mobilization of the joint, which is the keynote of modern postoperative joint therapy. Of course, no permanent strength is added to the bone by the presence of the wire after union is obtained, but we have never had to remove the wire in any of these cases, as silver wire is well tolerated by bone, and we have seen it heal in in drained cases of fractured long bones where it has been used for temporary fixation. In the recent case we drill the holes so as to bring the wire out on the fractured surface, but where great tension is likely to be thrown on it, as in old cases and those of refracture, we penetrate the entire thickness of the bone, to insure against cutting through when the wire is twisted tight (Fig. 93, 4). After passing the wire (Fig. 93, 5) the joint cavity is carefully cleansed, washed with ether, the wire suture tightened, and the fragments snugly fastened by twisting it (Fig. 93, 6). Suture of the fascia and the aponeurotic expansions, using a heavy chromic catgut, and utilizing the fascia which had united the fragments, is then carried out, and in this case a deep layer of mattress sutures and a superficial row of continuous stitches give an added strength to the repair (Fig.

93, 7, 8). The skin wound is then closed without drainage (Fig. 93, 9) and a splint applied.

The postoperative care will consist in fixation of the joint for five weeks, a much longer period than in recent cases, in which the splint can be removed in two weeks, as a longer time will be needed to favor the bony union which we hope to obtain. When the splint or cast is removed, active movement of the joint is directed. This is best done with the patient sitting or recumbent. While flexing the knee he assists himself by lifting the thigh with the hands, while the heel rests on the bed. These movements are practised by the patient himself several times a day in the same manner as we direct in the treatment of wounded and infected joints, and as taught by Willems. Passive movements of stiff and partially ankylosed joints are far inferior in efficacy and after-results to the active efforts of the patient himself, who always stops short of actual and injurious traumatism to the synovial tissues, which often results when the surgeon resorts to the so-called "breaking up of adhesions," a most injurious practice. Full weight is not placed on the limb for several weeks longer, and no risks taken of falling and breaking the recent union.

ECTOPIC TESTICLE: PERINEAL VARIETY. OPERATION AND IMPLANTATION OF TESTICLE IN THE SCROTUM

THIS patient is a well-developed boy of eight years, who since birth has presented this condition of abnormal descent of the right testicle. Examination shows that the right side of the scrotum is empty, is smaller than the left side, and that in the perineum, to the right of the median line, is a movable body, the size of the testicle, which admits of a considerable range of motion, and can be pushed forward to the spine of the pubes, and backward almost as far as the anterior border of the anal opening. There are no evidences of a hernia on either side.

This case offers an example of one of the varieties of abnormal migration or descent of the testis. The testicle may be arrested at any point in its normal route from the abdomen, constituting some one of the forms of undescended testicle, or it may occupy one of three locations entirely abnormal in relation to its normal position in intra-uterine life or after birth. These latter forms are grouped under the head of ectopia testis. The present case is one type of ectopia, and, while not common, is encountered more frequently than the others. The three types of ectopia are the perineal, where the testis is found in the perineum; the crural, where it descends to the thigh through the femoral canal; and the pubopenile, where it is located in the pubopenile region and beneath the sheath of the penis. Both of the last two forms are very rare.

It may be stated in a general way that any condition of abnormal descent or migration of the testis is a source of possible danger in future life to the individual exhibiting it. An abnormal location of the organ outside the abdomen exposes it to repeated traumatisms, which may lead to further atrophy of the already poorly developed gland, and which certainly offer every theoretic predisposition to the development of malignant disease. As to the proportion of cases of misplaced testicle which develop such malignant disease there has been much discussion, and there is a wide diversity of opinion, but we are convinced that they exceed the percentage observed in the normally placed organ. Replacement of the testicle in the scrotum before puberty gives the best chance possible for development, which rarely occurs when it remains in the abnormal position. In at least 60 per cent. of cases of arrested migration there is an associated hernial sac, and while strangulation is rare, it occasionally occurs, and as the pressure of a truss cannot be borne, operation is indicated on this ground as well. From six to twelve years is the most favorable time for the operation, as the structures are rather small for satisfactory work before the earlier age, and to leave the operation until after puberty is a great mistake, for the reasons already stated.

The operation for ectopic testicle of this type offers no great difficulty, as the cord is of ample length to permit the transplantation of the testicle in the scrotum. In the commoner cases of arrested descent the operation which Bevan has standardized is now generally adopted, with such occasional modifications as the individual case may demand. Some of the modifications which have been suggested, as Davisson's, for example, for lengthening the cord, are valuable in the exceptional case, but the operation as originally described will be found efficacious in the great majority of cases. It is seldom necessary, for example, to divide the spermatic vessels to bring the testicle to a satisfactory level in the scrotum, but some writers have laid great stress on this detail, claiming that it was an essential part of the technic. It rarely results in gangrene of the testicle, although this sometimes occurs. Even without this slight risk, it is poor policy to cut down the blood-supply of an organ which we wish to develop by dividing the spermatic vessels and trusting to the artery of the vas to furnish the nutrition. It should never be done unless it is absolutely necessary. We have emphasized this point before, and added experience has convinced us of the fact that it is seldom necessary if all strands of connective tissue, of peritoneal sac above the testicle, and of attached cremaster are separated and divided.

In this case, where simple transplantation is required, we begin our incision as for inguinal hernia, and carry the lower end through the scrotofemoral crease into the perineum. The inguinal canal is laid open, and the cord is observed to turn downward over the spine of the pubes into the perineum, where we find the testicle of normal size and development, and attached by a short, strong ligament to the tissues immediately in front of the anterior wall of the rectum. No hernia is present. The attachment of the testis to the deep structures of the perineum is divided, freeing it and the cord. The right side of the scrotum is opened by blunt dissection, the testicle placed in it, and the distal end secured by sutures passing through the tunica vaginalis and the bottom of the scrotum. As the scrotum is underdeveloped on this side, and the testicle tends to slip upward and be crowded out, we pass a purse-string suture through the tissues at the mouth of the scrotum, above the cord (Bevan technic), and as an additional security suture the margin of the cord to the structures in the same neighborhood by a single stitch (Dowd sutured it to the pillars of the external ring in operation for undescended testicle). The canal is closed in the usual manner without disturbing the cord at this point, and, of course, without transplanting it. The operation is concluded by suture of the skin in the usual manner.

PRIMARY HEMANGIOMATOUS ENDOTHELIOMA OF THE SPLEEN. SPLENECTOMY

THE patient is an Italian woman, thirty-three years of age, admitted to the hospital eight days ago with the following history:

She is married, and the mother of 4 living children, having lost one with influenza. She had always been well until five months ago, when she discovered a lump under the left costal margin, the size, she says, of a lemon. At the same time she began to suffer with upper abdominal pain radiating to the right kidney region, which kept her awake at night. The tumor kept increasing in size, and while she has not much pain at present, she states she cannot sleep on the right side. She has lost much weight, she says 100 pounds, although this seems excessive, suffers with daily headaches, and has little appetite. For some time her skin has had a yellow tinge.

Physical examination shows a marked emaciation and the appearances of pronounced anemia. The chest examination is negative, as is that of the nervous system. Abdominal examination demonstrates a hard nodular tumor in the left upper quadrant, which extends a full handbreadth below the costal margin, almost to the navel and quite to the median line. It moves with respiration and with change of posture, and by its contour and location is readily recognized as an enlarged spleen.

Laboratory findings are as follows: Urine, 1030, acid, no albumin or sugar, a few epithelial and white blood-cells. Blood: Wassermann negative. R. B. C. 2,450,000; W. B. C. 14,800. Hemoglobin 46 per cent. Differential count: Polys., 53 per cent.; large lymphocytes, 4 per cent.; small, 38 per cent.; large mononuc., 1 per cent.; trans., 2 per cent.; baso., 2 per cent. Anisocytosis marked; microblasts, moderate numbers; megaloblasts, 0; poikilocytosis, marked; polychromatophilia, marked. Malarial parasites none. Fragility of R. B. C., partial hemolysis, 0.4 per cent. saline; complete hemolysis, 0.3 per cent.

Phenolsulphonephthalein elimination: 1. Amount, 80 c.c., P. S. P., 15 per cent. 2. Amount, 60 c.c., P. S. P., 10 per cent.

A second examination of the blood yesterday gave practically the same findings.

Dr. John H. Musser, Jr., has examined the patient, and is inclined to consider the case as one of Banti's disease, in the second stage. In view of the patient's nationality, the possibility of malarial enlargement is also borne in mind. In any event, splenectomy is indicated.

Our incision is a straight one to the left of the median line through the rectus muscle, and sufficiently long to give an ample exposure, and room for our manipulations. The spleen, much enlarged and curved on itself, is quite firmly attached by adhesions, especially on its outer surface, and upper pole, to the diaphragm, stomach, and under surface and outer edge of the left lobe of the liver. These adhesions are gradually separated by the hand, and without exciting much hemorrhage, until the viscus is freed and rotated inward, when the pedicle is accessible to ligature. The splenic artery is tied first, then the veins, and the spleen removed. A raw surface on the edge of the liver oozes, and requires the application of several catgut sutures to check the hemorrhage. The cavity left is wiped dry and the wound closed. The patient leaves the table after operation, which has been conducted under morphin, gas, and ether, in fair condition; 650 c. c. of normal saline solution have been instilled under the breasts during the operation. The pulse at the conclusion is 132, having been 100 at the beginning; 1 grain of camphor is given hypodermically.

The after-history of this patient is not without interest. Her condition the same evening was precarious, and the weak pulse, shallow respirations, and air-hunger were sufficient to indicate a blood transfusion, which was carried out by Dr. Speese, the donor being the patient's brother. The reaction to the same was prompt and satisfactory. Her convalescence was marked by a temperature which subsided in a week, but rose again and persisted for two weeks longer, and was due either to a limited area of pulmonary consolidation, or, as seemed more likely, to slow absorption of clot from the bed of the spleen. On September 26th, five days after operation, blood examination showed R. B. C., 1,980,000; hemoglobin, 43 per cent. October 1st: R. B. C., 2,280,000; W. B. C., 15,200; hemoglobin, 55 per cent. October 8th: R. B. C., 2,800,000; W. B. C., 8600; hemoglobin, 55 per cent. Anisocytosis, poikilocytosis, very slight, no nucleated R. B. C.

After subsidence of fever convalescence was rapid and normal. She left the hospital on October 30th, and was not seen again until November 22d, when she was found to be doing well, gaining in weight and strength, and with her anemia greatly improved. A blood count taken on this date showed: R. B. C., 4,780,000; W. B. C. not taken; hemoglobin, 83 per cent.; color index, 0.86; polys., 76; large lymph., 6; small lymph., 16; tr., 2; anisocytosis slight; poikilocytosis very slight. Nucleated R. B. C. none seen. Polychromatophilia, a few cells; basophilic degeneration none.

The report of the pathologist to the hospital is appended. Dr. Nelson F. Percy, whose experience in the surgery of the spleen is very large, saw this patient during her convalescence, and examined the specimen and the histologic slides. He informs us that he has has but one case which was similar to this, of an undiagnosed type, which developed a polycythemia after splenectomy, having had a mild secondary anemia before operation. After operation the red blood-cells rose to 10,000,000, the patient suffered a variety of nervous and other symptoms, and the condition was only kept under control by using him for a donor on several occasions, after which there was an improvement which promised to be lasting.

Pathologic Report by Dr. John Eiman, Pathologist to the Hospital.—Spleen weighs 1590 gm. and measures 22.5 x 16.5 x 7.5 cm. (Fig. 94). The upper pole is bent on itself. The spleen is firm in consistency. The external surface over the upper third is covered with dense fibrous adhesions. The remaining surface of the spleen is fairly smooth; however, it shows here and there irregular small patches of "zuckerguss" and a few scattered fibrous adhesions. Over the areas where there are no adhesions and no "zuckerguss" the capsule shows no thickening. Here and there are seen through the capsule ill-defined, firm, yellowish areas which vary in size from a pin-point to 2 cm. in diameter. Over some of these areas the surface is slightly raised.

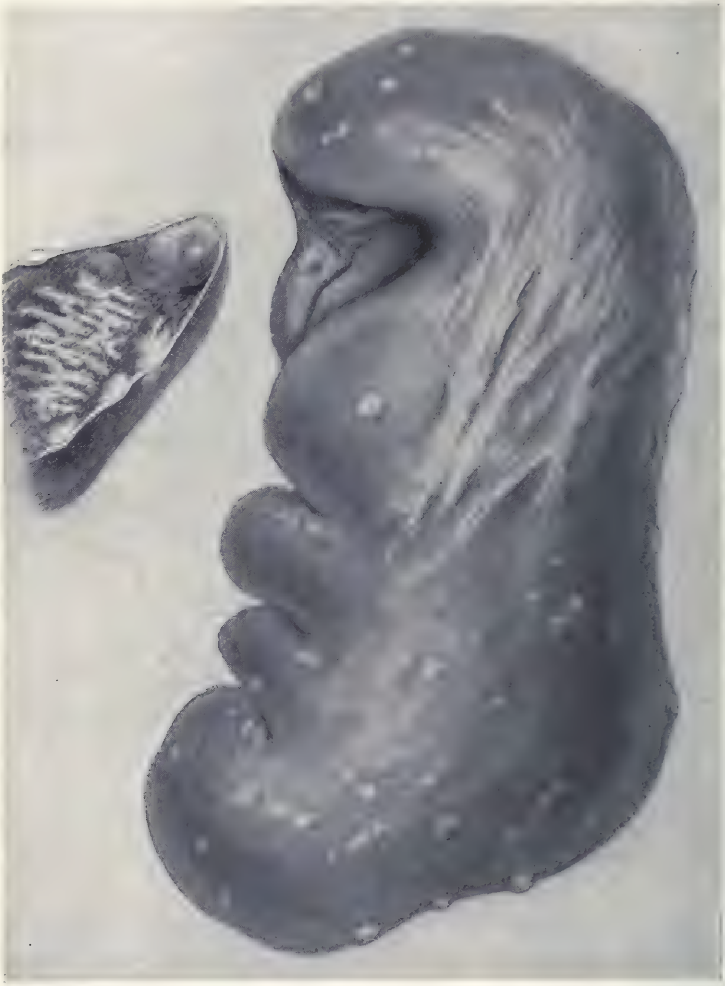


Fig. 94.—Hemangiomatous endothelioma of the spleen. On the left is seen the cut section, showing the yellow areas, yellow in color in the specimen, representing connective-tissue replacement.

The anterior border shows three notches, the deepest of which measures 3 cm.

It cuts with increased resistance. The cut surface bulges. It is mottled, grayish to dark red, with very irregular yellowish areas scattered throughout. The yellowish areas vary in size from a split pea to 3.8 cm. in diameter. They are hard and woody in consistency and show no evidences of encapsulation. In their distribution and relation to the capsule they do not resemble infarcts, but appear to be neoplastic in character.

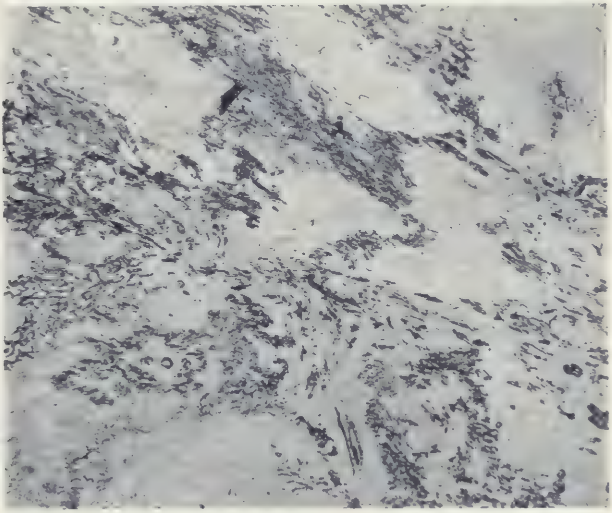


Fig. 95.—Section from hard, yellow area; hyalinized connective tissue with calcareous infiltration and deposits of hemosiderin. (Low power.)

The grayish areas are fairly firm and fleshy in consistency. They are ill-defined and vary in size from a pinhead to 2.2 cm. in diameter. The reddish portions have the consistency of fairly firm splenic pulp.

Microscopic.—Capsule shows areas of thickening and hyalinization of connective tissue. Also shows fibrous adhesions. The architecture of the spleen is disarranged; definite follicles and cords cannot be made out. Sections from the hard yellow areas (Fig. 95) show irregular masses of dense connective tissue

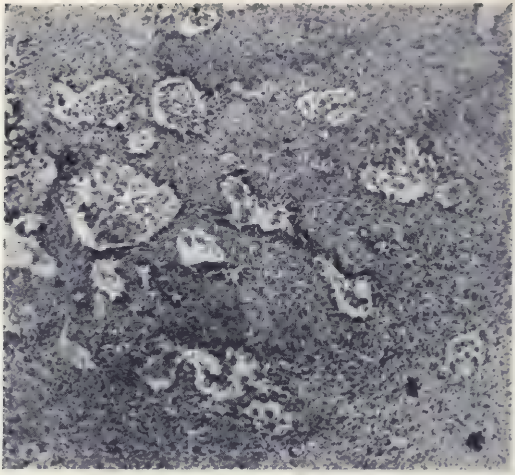


Fig. 96.—Section from reddish area showing irregular blood spaces lined with polyhedral cells. (Low power.)

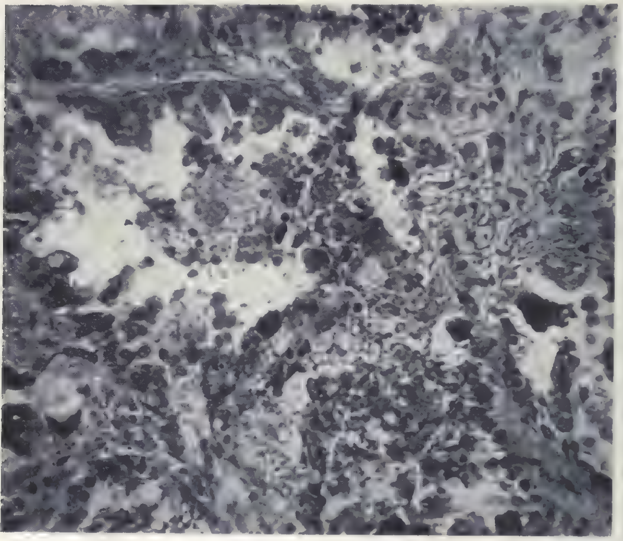


Fig. 97.—High power of Fig. 96.

which shows hyalinization and deposits of calcium salts and fairly large amounts of amorphous fine dark brown pigment, most likely hemosiderin. The sections from the reddish portions (Figs. 96, 97) show numerous somewhat irregular blood spaces which vary greatly in size. Most of them are filled with red cells and lined with large polyhedral or spindle-shaped cells which show large vesicular nuclei. These cells proliferate outside the walls of the vessels, forming diffusely disseminated tumor masses of varying size. Sections from the grayish areas (Fig. 98) show solid tumor masses composed of roughly spindle-shaped cells with vesicular nuclei. They show no definite arrangement. Here and there are seen a few giant cells. The tumor masses show no evidence of encapsulation.

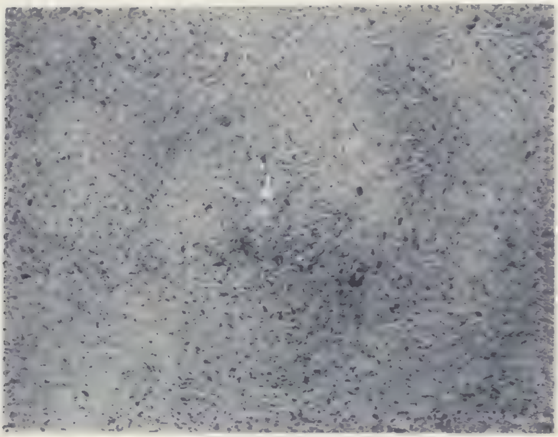


Fig. 98.—Section from a grayish area showing a solid tumor composed of roughly spindle-shaped cells and moderate numbers of giant-cells. (Low power.)

Diagnosis.—Hemangiomatous endothelioma of the spleen. (The yellow hard areas probably represent areas in the neoplasm which have undergone retrograde changes and connective tissue replacement.)

CLINIC OF DR. GEORGE P. MULLER

UNIVERSITY HOSPITAL

LARGE ENCHONDROMA OF SCAPULA OF MANY YEARS' DURATION. EXCISION OF TUMOR AND SCAPULA FOLLOWED BY LOCAL RECURRENCES

THE first case which I wish to show you is an example of a large enchondroma of the scapula.

J. T. Age forty-six. Printer by trade. Since a boy, exact date unknown, he has had a mass on the shoulder over the scapula, but it was not until four years ago that it began to grow progressively larger. He was admitted to the St. Agnes Hospital May 14, 1918 (Figs. 99, 100). On May 18th, under ether

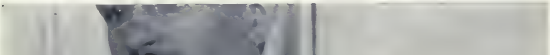


Fig. 99.—Enchondroma of scapula.

anesthesia, I removed the tumor and scapula. The operation was prolonged, but he reacted well. On June 26, 1918 the wound was entirely healed. The pathologic report (Dr. John Fenz) was as follows: Specimen No. 3399 is a large three-lobed mass, 26 cm. in its greatest diameter by 24 by 20 cm. Exterior surface is red except an area 12 cm. square, which is attached skin. This upper surface is concave to conform with underlying thoracic contour. Tissue cuts with a fibrous resistance, and knife grates on hard material at parts. Cut surface is irregular, granular, and mottled, pearly white at certain areas. At one portion of mass glenoid fossa of scapula appears, with the overhanging acromion process, body of scapula is lost in the tumor mass. Tumor mass weighs 4820 gm.

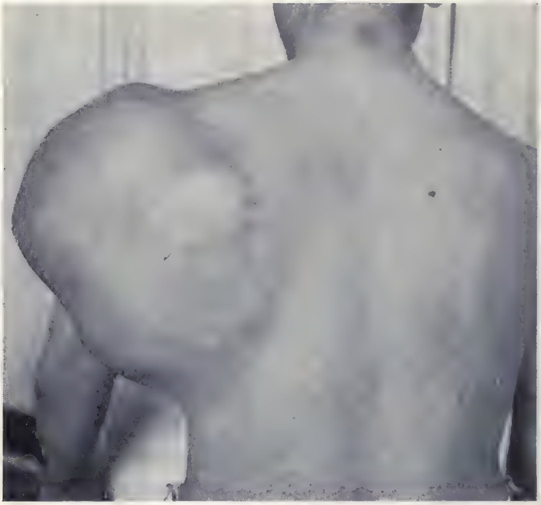


Fig. 100.—Enchondroma of scapula, posterior view.

Histologic sections reveal the tumor to be made up of cartilage, which is mostly of the hyaline variety, although areas are found composed of fibrocartilage. Calcific infiltration is present at many portions. Islands of cartilage are surrounded by fibrous tissues. No mitotic figures are present in the chondroblasts. Histologic diagnosis: Chondroma with calcareous infiltration, evidently of periosteal or perichondrial origin, from scapula.

In the summer of 1919 he noted a small mass was present in the posterior axillary region at the lower end of the scar. This slowly increased in size, and on December 3, 1919 he was admitted to the Univeristy Hospital, when the mass was found to be free, movable, nodular, and about 8 cm. in diameter. Under nitrous-oxid oxygen anesthesia it was dissected out (December 4, 1919). The wound healed by primary union.

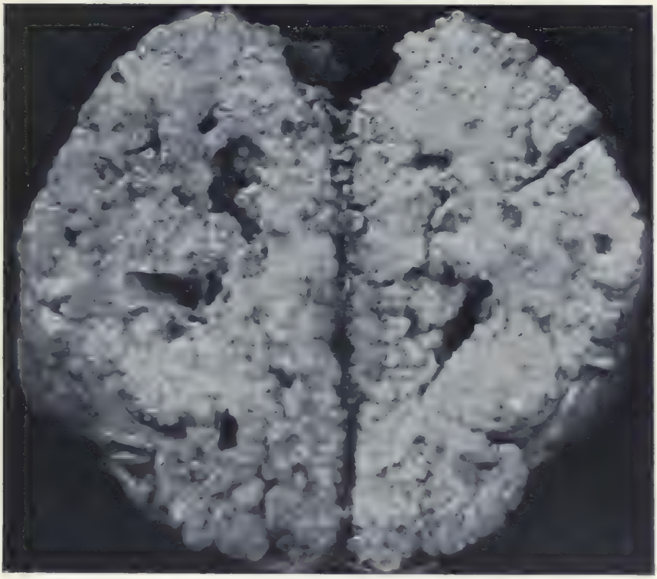


Fig. 101.—Enchondroma of scapula, section surface of recurrent mass. Large original tumor except that latter had fibrous tissue.

After discharge the patient later stated that he noted a little lump high on the shoulder. We did not detect it, however. It grew rapidly, and in August, 1920 had attained a large size. He was readmitted, and at the base of the neck a large mass, hard, movable, and nodular, was found wedged behind the clavicle. Again, under nitrous oxid-oxygen anesthesia (August 5, 1920), the mass was exposed and removed. It was adherent to the clavicle and the chisel was used at this point. The wound healed. The pathologic report follows: Specimen (Fig. 101) consists of an oval-shaped tumor measuring 20 x 10 x 10 cm. and weighing 510 grams. It is well encapsulated, hard in consistency, nodular, and cuts like cartilage, showing a white retracted lobulated interior with some irregular areas of softening, the consistency and appearance being that of cartilage. Microscopic examination shows cartilaginous tissue (Fig. 102).

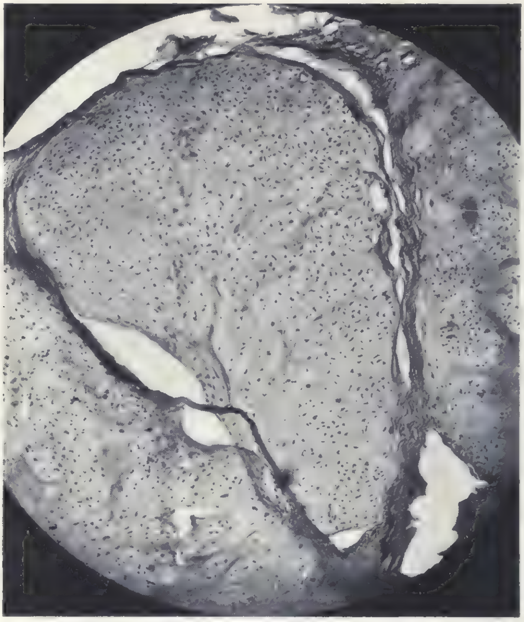


Fig. 102.—Low-power microphotograph of enchondroma tissue.

An enchondroma is a rather common tumor, and is usually located in the diaphysis of the long bones. A number of cases have been reported as occurring in the scapula and Deganello has collected 39 cases. Some of them have attained huge proportions, and one weighed 17 pounds. It will be noted that our specimen weighed about 10 pounds. The growth arises from any part of the bone and presents the characteristic appearance and microscopic evidence of cartilaginous tissue, often with mucoid degeneration. Some are chondrosarcomas, in which case recurrence or metastasis to the lungs will be found to be the rule.

I frankly admit that this case was suspected to be sarcomatous by reason of the later rapid growth, and for this reason no attempt was made to save the glenoid cavity of the scapula. Consequently, he lost the use of the muscles attached to the scapula, but the man, a printer, is no more deformed than before the operation, when the growth itself interfered with the use of the shoulder and scapular muscles.

ENCHONDROMA OF SCAPULA AND LONG BONES (MULTIPLE CARTILAGINOUS EXOSTOSES)

Somewhat allied to this case is the following: The patient is eighteen years of age, and when ten years of age first noticed a small, hard, nodular growth on the right scapula which has been progressively increasing in size. Three years later she also noticed a hard lump in the right popliteal space. A little later a mass appeared below the right knee and also on the phalanges of the hands.

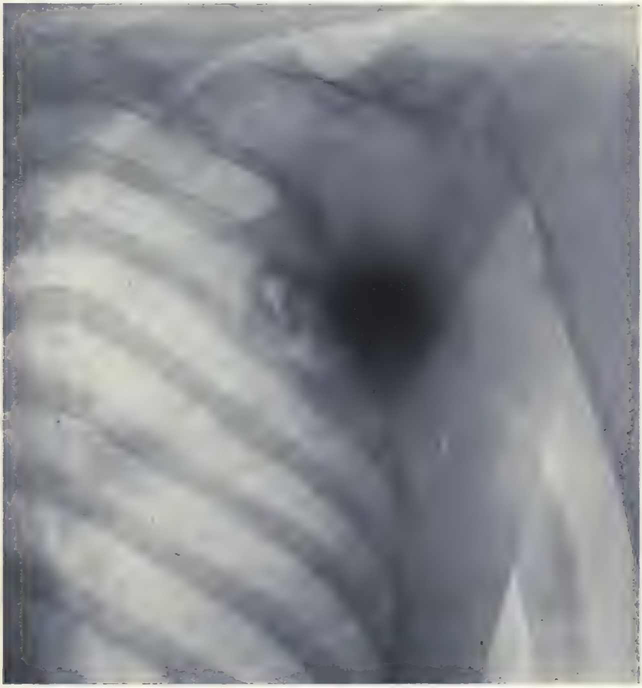


Fig. 103.—Small enchondroma on scapula. Patient had multiple lesions.

There is nothing significant in the previous history. She had measles, and when seven years old was struck by lightning, being rendered unconscious for about five hours. In addition to the demonstrable growths you will notice that there is an enlargement of each epiphyseal region. The Wassermann reaction is reported negative. On October 21, 1919 at another hospital (St. Agnes) I chiselled off the mass on the scapula (Figs. 103, 104) and the one in the popliteal space (Fig. 105) which was attached to the femur. She now returns suffering with some pain in the region of the right knee, but refuses further operative interference.

This case may be considered as one of multiple cartilaginous exostoses. A very large literature has arisen about this disease, and it is often termed hereditary deforming chondroplasia, a history of heredity being obtained in about 50 per cent. of the cases. Honeij (Archives Int. Med., 1920, 25, 584) in a recent paper collects 66 reported cases. He found the bones affected in the following order of frequency: The femur was affected in 43 cases; tibia in 35 cases, humerus in 29 cases; fibula in 27 cases; radius in 25 cases; ulna in 24 cases; phalanges in 20 cases; ribs in 19 cases; scapula in 17 cases; pelvic bones in 13 cases; clavicle and metacarpals in 12 cases each; metatarsal bones in 6 cases; skull bones in 6 cases; knee in 4 cases; the spine and tarsal bones in 2 cases each, and the sternum in 1

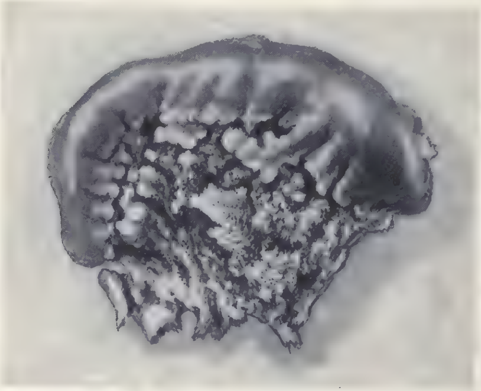


Fig. 104.—Enchondroma of scapula. Specimen removed from patient with multiple lesions. Was about 3 cm. in length.

case. Honeij studied 2 cases from the standpoint of metabolism, and suggests that in the early stages a check may perhaps be given to the progress of the disease by proper dietary procedure.

Many of the cases in the literature do not distinguish between the multiple cartilaginous exostosis and the mechanical or traumatic exostosis. Eliot reported an interesting case before the American Surgical Association last year, and believes that following contusion of bone the extravasated blood collects beneath the periosteum and may be the starting-point of a more or less actively growing pointed exostosis.

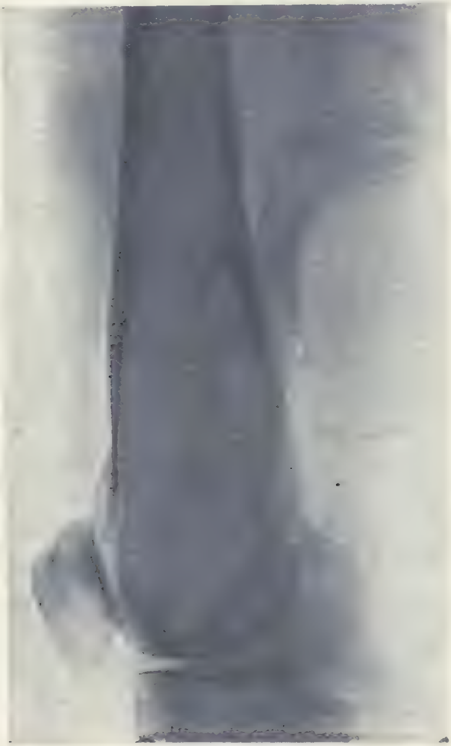


Fig. 105.—Osteochondroma of femur. Patient had multiple lesions.

CHONDRO-OSTEOMA OF HUMERUS IN YOUNG BOY (DEVELOPMENTAL EXOSTOSES RESEMBLING SARCOMA)

THIS boy (Fig. 106) was admitted to my service in another hospital (Misericordiæ) in October, 1919, with the following history: When about three years old a hard mass was first noted in the upper arm and attached to the bone. It gradually increased in size since, but has never caused pain or other symptoms except interference with the free motion of the muscles. It was diagnosed as a sarcoma by several physicians in the boy's home town and amputation advised. It was a typical osteoma, however, and conservative measures believed proper. The growth was on the inner and posterior aspect of the left humerus just below the axillary fold (Fig. 107).

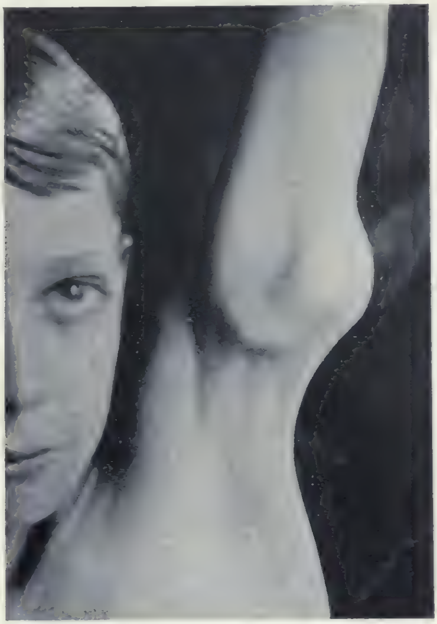


Fig. 106.—Osteochondroma of humerus in a boy.

Under ether anesthesia the tumor was exposed and found to be attached to the humerus by a narrow pedicle. This was chiseled through close to the shaft and the mass easily enucleated from the surrounding muscles without endangering the musculospiral nerve (Fig. 108). The pathologist, Dr. Paul, reported the tumor to be an osteochondroma.

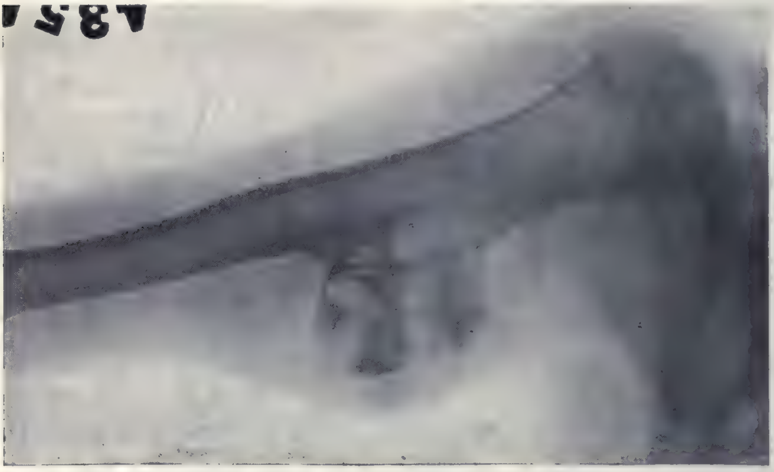


Fig. 107.—Osteochondroma of humerus. Developmental exostoses.

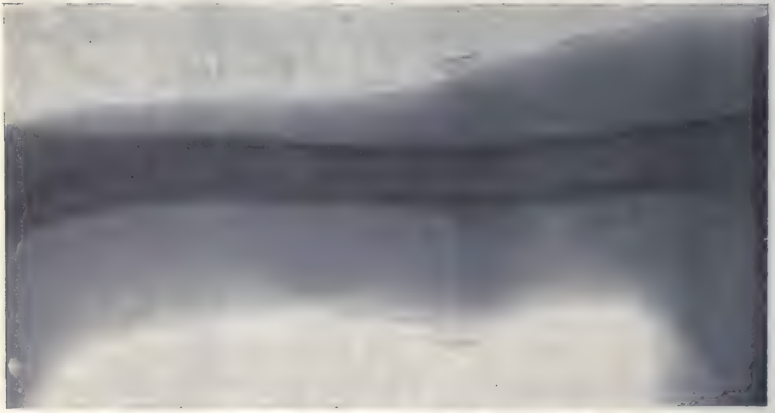


Fig. 108.—Appearance of humerus two weeks after removal of osteochondroma.

MULTILOCULAR CYST (ADAMANTINOMA) OF LOWER JAW, TREATED BY SIMPLE EXCISION AND FOLLOWED BY CURE FOR A PERIOD OF THREE YEARS

I HAVE always been interested in the epithelial odontomes, and the next patient is an example of this affection, presenting many interesting features. He is a physician by occupation, and stated that fifteen years previously he had a wisdom tooth extracted. As more or less pain persisted, he consulted an oral surgeon three or four years later, but was told the matter would soon clear up. In 1911 an *x*-ray picture was taken and an impacted root of a wisdom tooth noted. Nothing else was said

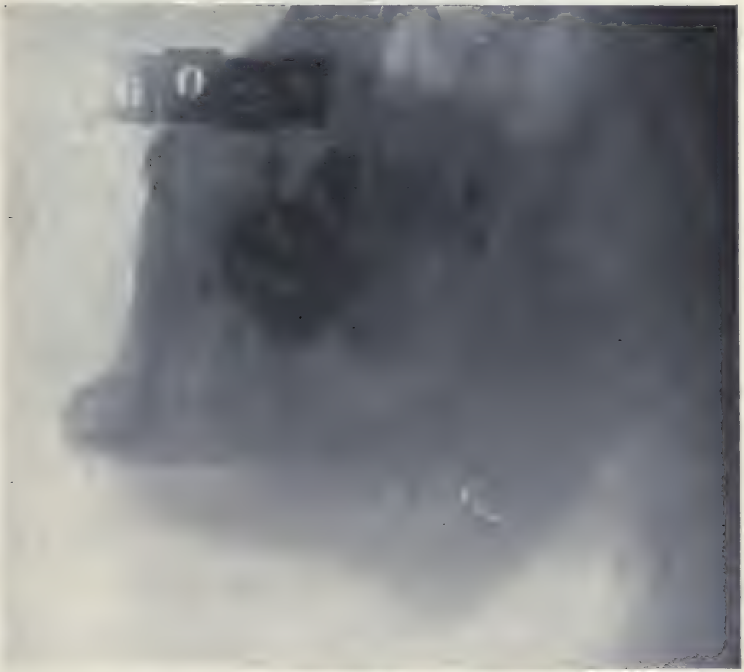


Fig. 109.—Early appearance of adamantinoma in the jaw.

about the *x*-rays. In 1917 more *x*-rays were made, but nothing definite was determined, although later examination of these plates (Fig. 109) revealed a suspicious shadow. In January, 1918 he was examined by Dr. G. E. Pfahler (Fig. 110), who referred him to me, and a definite diagnosis of adamantine epithelioma made.

The operation was performed in the University Hospital February 5, 1918 under ether anesthesia. The jaw-bone was exposed and perforated with a gouge chisel. A cyst was encountered containing a brownish, solid material. The entire roof of the cyst was removed with rongeur forceps and a communication found with another cyst. As the operation continued about six of these cysts were encountered, the final opening extending nearly to the tip of the coronoid. All cavities were thoroughly opened up, cureted, and the bone smoothed with the burr. The bone was then thoroughly cauterized and disinfected with iodin. The wound healed well.

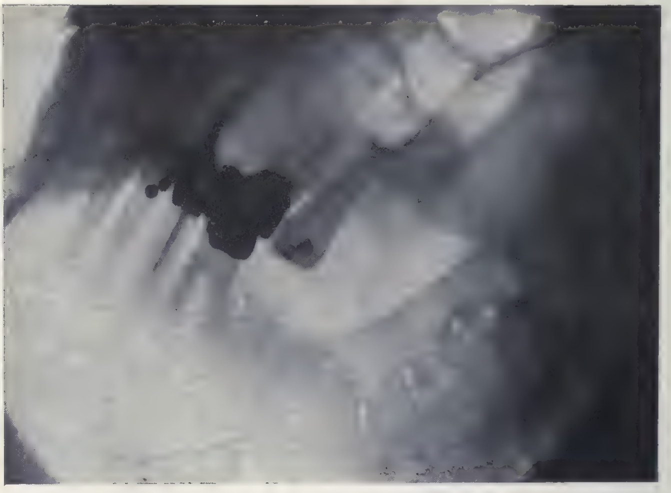


Fig. 110.—Honeycomb appearance of growth in jaw one year later than pictured in Fig. 109.

The pathologic examination was made by Dr. Speese and "sections in each fragment showed several small cysts lined by stratified squamous epithelium and more or less completely occupied by closely packed cells of the same type. These occur in a loose fibrocellular connective tissue of indeterminate source. They may well represent epithelial penetrations in the deeper gum tissue, with secondary cyst development in the penetrating epithelial roots" (Fig. 111).

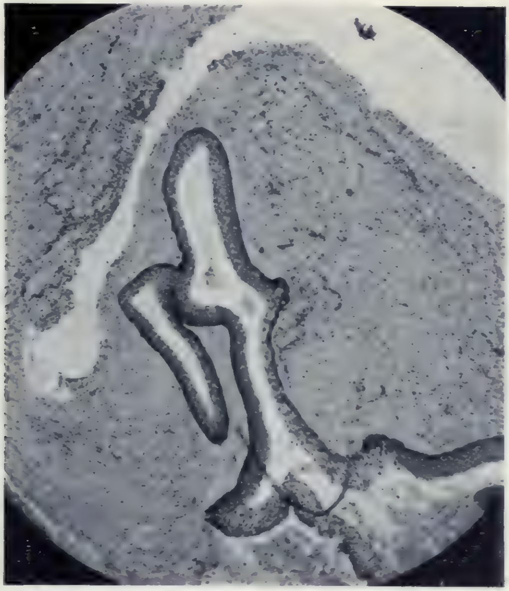


Fig. 111.—Lower-power microphotograph of cystic epithelial growth (adamantinoma).

In September, 1918 Dr. Pfahler reported finding the angle of the jaw and the general jaw-bone healthy (Fig. 112). The patient has remained perfectly well.

One of the simplest classifications of these cystic tumors of the jaw is that of Wohl (Annals of Surgery, 1916, 64, 672). He divides them into: A. Inflammatory cysts (dental and root cysts). B. Tooth germ or chorioblastomatous cysts.

The latter are subdivided into: (*a*) the unilocular cyst commonly known as the dentigerous or follicular cyst; (*b*) multilocular cyst, conventionally designated as adamantine epithelioma, multilocular dentigerous cyst; and (*c*) the solid tumor.

A somewhat different classification was adopted in the Report of the Committee of the British Dental Association in 1914. The main divisions were: (1) epithelial odontomes, where the abnormal development takes place in the dental epithelium alone; (2) composite odontomes, where the abnormal development takes place primarily in the dental epithelium, and secondarily in the dental papilla, and may occur in the follicle also; and, (3) connective-tissue odontomes, where the abnormal development takes place in the dental tissues of mesoplastic origin alone. The multilocular cyst is classed in the first group.

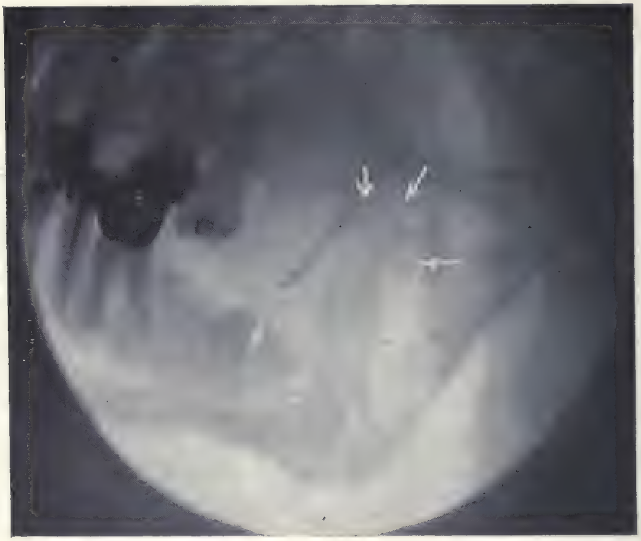


Fig. 112.—*x*-Ray appearance of jaw seven months after operation.

The adamantinomas are most frequently seen in the lower jaw, and are usually situated at the angle. They may occur at any age, the average in Lewis' (Surg., Gyn., Obs., 1910, 10, 25) collection was thirty-three. Several theories have been advanced for their occurrence, but the most popular is that of Malassez (1885), who states that they are due to an overgrowth of the rudimentary paradental epithelium. An excellent description will be found in Ewing's book on Neoplastic Diseases.

In the case shown the jaw was only slightly enlarged, and at operation appeared "honeycombed" by the growth. In the larger tumors reported in the literature the cysts were large and filled with fluid. In a few cases the cyst resembles a dentigerous cyst (unilocular), but the adamantine lining could be demonstrated. The solid areas consist of masses of spheroidal epithelial cells arranged in layers or alveoli and with a degenerating center. The outer layer may be typically columnar and the inner composed of stellate cells corresponding to the enamel pulp.

The diagnosis rests on the slow growth, the absence of teeth over the part involved, and the *x*-ray appearance of the multilocular cyst. The latter was typical in this patient. Care must be taken at the time of operation to differentiate a sarcoma. You will find that, as a rule, radical extirpation is advised by means of a resection of the jaw because of the fear of recurrence. In this patient the cavities were followed up with the chisel and curet, and to destroy any outlying particles I used the actual cautery. The patient has been free from recurrence for three years, and the result justifies the conservative measure employed. In very large cysts with a thinned maxilla I believe that resection and, later, bone transplantation would be indicated.

THE SURGICAL CLINICS OF NORTH AMERICA

VOLUME 1 NUMBER 2

CLINIC OF DR. JOHN F. ERDMANN

POST-GRADUATE HOSPITAL

EXOPHTHALMIC GOITER

THE first patient is a woman thirty-one years of age who has been in the hospital under observation for ten days. She gives the following history:

Chief Complaint.—Choking sensation, change in voice and nervousness.

Family History.—Negative for goiter, tuberculosis, and cancer.

Past History.—Scarlet fever when a child, very sick. Influenza in 1918 and again in 1919. Nervous breakdown in 1915, which required residence in the country and careful treatment for one year.

Symptoms at that time were: weakness, severe headache, and insomnia.

Personal History.—Menstruation began at twelve, regular, one and a half days, small amount. Since marriage regular, two and a half days, moderate. No change with the present condition. Married eight years, with two full term and one seven months' pregnancies.

Present Condition.—In 1917, shortly after the second child was born, the enlargement of the neck was first noticed. There has been a gradual increase accompanied by the following symptoms in the order of appearance: Hoarseness and a change in the quality of the voice; weakness, to the present exhaustion; sweating from the least exertion, profuse at present; itching of skin, troublesome at times; diarrhea for six months, in attacks of one week to ten days, no blood in stools; palpitation from exertion and excitement is becoming rapidly worse; shortness of breath when climbing stairs, particularly in the last two months; weight loss, 90 pounds in four years; hair has been falling out in large quantities for six months, and has become straight and fine.

Physical examination on admission to the hospital:

General Appearance.—Unduly excited by introduction, worried, looks frightened, face flushed and cheek bones prominent, eyes protrude and pupils are widely dilated. Movements are rapid, inclined to be jerky, talking seems to tire patient quickly, the voice is unnatural and weak.

Head.—Hair is very fine, thin, dry, and lifeless. Eyes are prominent, von Graefe's positive, pupils dilated, equal, and react normally to light and accommodation, tension equal, movements normal. Mouth: teeth have had poor repair of large cavities, bridge-work in poor condition. Larynx: cords slightly granular in appearance, movements normal, no paralysis, change in voice not due to anything detected by indirect examination.

Neck.—Typical thyroid enlargement, right lobe size of lemon, smooth, and generally enlarged; left lobe visible. Pulsation of tumor visible, moves with swallowing, freely movable from side to side, equal consistency throughout, soft, and non-fluctuant. Bruit heard over right lobe distinctly.

Heart.—Normal size, sounds of good quality, occasional extrasystole. Systolic murmur at base.

Lungs.—Expansion equal, no consolidation, generalized bronchitis. Sputum negative for tuberculosis. Alveolar CO_2; tension 45.

Abdomen.—Negative.

Extremities.—Cool and moist. Reflexes normal. Pulse 120, small and easily compressible. Blood-pressure: 165 systolic, 90 diastolic.

Basal metabolism: Nervous and excitable; poor co-operation. Rate of 60.

The patient was placed in bed immediately in a quiet room with a special nurse. There is little that affects the reduction of toxemia in these patients beyond rest and comfort. Suggestion by the nurse and doctors plays no little part in securing rest and putting the patient at ease, and every opportunity to encourage the patient as to the outcome of the treatment should be taken advantage of.

An ice-bag has been applied to pericardium, two hours on and two hours off, for past week.

The only drugs administered have been triple bromids, grains xx, t. i. d.; codein, grain $\frac{1}{4}$, for cough when troublesome at night, and a mild cathartic pill to keep the bowels open. Diet has consisted of the routine hospital meals with restriction of fats for the past few days. The patient has been encouraged to drink water freely. Ice-cap to heart, two hours on, two hours off.

Tenth day following admission:

General Appearance.—Quiet and rested, bright and cheerful. Anxious only to have the operation over.

Temperature 99.4° F. (rectal). Pulse 100, regular, of good quality. Blood-pressure 150/90. Metabolic rate 45. Normal 37.5. Examination of urine negative.

Preparation for Operation.—Day preceding: Soda bicarbonate 15 grams by mouth. Pulv. glyc. 3 drams. Tap-water 1000 c.c. by rectum unless the patient is disturbed. This patient took 750 c.c. while sleeping last night. Neck is prepared by shaving only, when this is necessary.

Day of operation: Light breakfast for afternoon operation. Small S. S. enema three hours before operation. No lunch is given, but tea or water may be taken until one hour and a half before operation. One hour before operation, morphin, grain $\frac{1}{8}$, and atropin, gr. $\frac{1}{50}$.

Anesthetic has been nitrous oxid and ether, closed method. Pulse at the beginning of operation 120, color good, breathing quietly.

Preparation of field: One application of 3.5 per cent. tincture of iodin.

Position: Dorsal, small sand-bag under shoulders, chin up, head back.

Operation (Dr. Erdmann).—I make the usual collar incision, here taking care to place the incision low, so that it may be covered later by the ordinary string of beads. You will notice that I cut through skin and platysma to the muscles before I begin reflecting the flap upward. There is considerable bleeding in this case, as is usual in cases of hyperplasia. By separating the muscles the entire length of the reflection I hope to be able to deliver the gland without cutting across the muscles. The gland with its capsule protrudes into the separation; it is not adherent to the capsule which strips away readily. I am delivering this right lobe with some difficulty; as it is considerably enlarged, however, I will not have to divide the muscles. The lower pole is the most accessible, and I begin by clamping the blood-supply here, leaving a part of the gland and all of the posterior capsule to avoid injury to the parathyroid and recurrent laryngeal nerve. The isthmus is enlarged and we will remove that in the same way. Now we will tie off these clamps and then examine the left lobe again. The left lobe is not cystic, nor is it enlarged to any extent.

This gross specimen has some parts that appear colloid, and in other parts it is quite hard or hyperplastic. I do not wish you to think for a moment that it has the marks of malignancy, but they are marks of typical hyperplasia. Dr. Carter in sewing the wound is going to take in the deep fascia with the platysma, so there will be a much better scar. The drainage we place in will be allowed to remain forty-eight to seventy-two hours. It is extremely essential, in suturing the skin, that you do not puncture the jugular veins, as the hemorrhage is so severe that deeper sutures would have to be removed to control the bleeding.

We will give this patient immediately upon going to bed in the ward or room 1000 c.c. of tap-water containing 1 ounce of bicarbonate of soda and 1½ ounces of glucose, in a Murphy drip, and a sufficient amount of morphin to control her absolutely. The patient is apt to be excitable and she may require anything from ⅓ to ½ grain. We will start her with ⅙ grain. She should have her preliminary before the operation. Hyperthyroidism following operation ends fatally, if at all, at the end of a few hours, usually in eighteen to twenty-four. The patients develop a high temperature between twenty-two to twenty-three hours postoperative. It is rare to have a postoperative hyperthyroid case die on the second or third day. The pulse now is 118, color is good, and respiration is easy and smooth.

The postoperative temperature sheet is reproduced here, showing a recovery of a borderline case. Twenty-three hours after operation the patient became very restless, not irrational, and the temperature rose to 104° F. She received $\frac{5}{8}$ grain of morphin in the first twenty-four hours. She did not retain the Murphy drip, so it was discontinued, and fluids were given by the mouth and retained. In the second twenty-four hours the temperature again rose to 104.6° F., with extreme restlessness. The pulse was rapid, intermittent, and of poor quality. Ice-bags were applied to each groin, pericardium, and to the head.

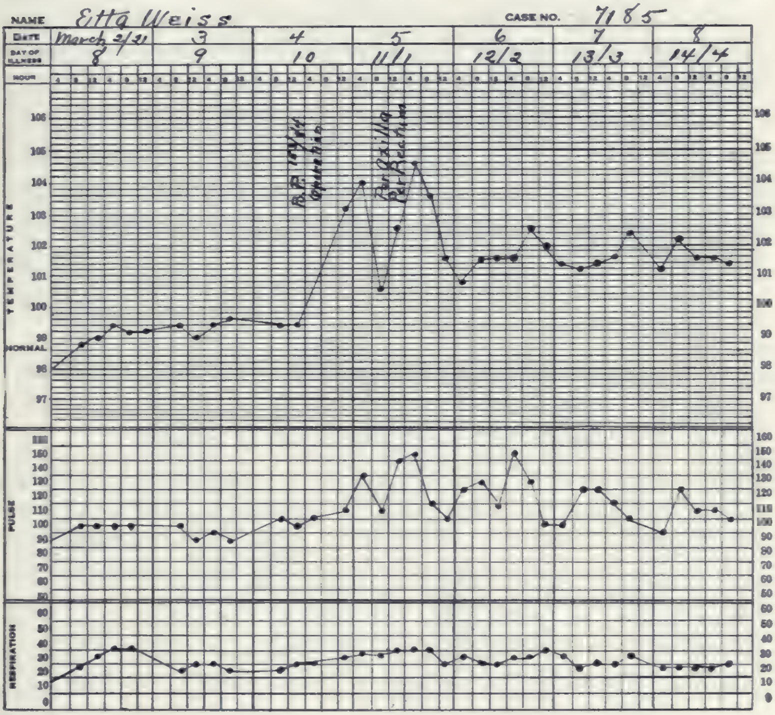


Fig. 113.—Case I.

Morphin, grain $\frac{2}{3}$, and sodium bromid, 130 grains, was given during the twenty-four hours. The bromid will control the restlessness better in some cases than morphin, and in this case it was so. The temperature did not rise above 102° F. again, the patient quieted down, and the pulse gradually came down to an average of 85 when the patient left the hospital on the twentieth day.

Pathologic Examination of the Tissue.—Gross: Total weight 27 grams. The exterior is lobulated, but covered by smooth membrane. On section it is fleshy throughout and rather firm.

Microscopic.—Sections show in part thyroid acini, more or less dilated by colloid material. Some areas, however, show edematous hyperplasia with tendency to papillary formations of the epithelium lining the acini—a hyperplasia usually associated with exophthalmic goiter.

Diagnosis.—Goiter, partly colloid and partly Graves in type.

CYSTIC ADENOMA OF OVARY

The next patient is a woman fifty-four years of age who complains of a rapidly growing tumor of the lower abdomen. She gives the following history:

Chief Complaint.—Tumor of lower abdomen. Duration five months.

Family History.—Negative for cancer and tuberculosis.

Past History.—Operation ten years ago for a mass in the abdomen, appendix was removed at that time. Another operation seven years ago, when something was done to her tubes, ovaries, and uterus, but just what she was unable to tell us. Pneumonia nine years ago, sick in bed for three weeks.

Personal History.—Married, three normal children, four miscarriages. Otherwise normal.

Present History.—Attention called to abdomen by the size of mass five months ago. Has increased rapidly in size, accompanied by hemorrhage from vagina, beginning one month after the onset and lasting for thirty days, profuse for first few days, with rapid diminution. Frequent urination for six months; very frequent and small in amount at present. Backache and dragging sensation in pelvis for three months. Constipation for six months. Fatigue very noticeable of late. There has been no loss in weight, and, in fact, she states there has been a gain (probably due to the tumor).

Physical examination on admission to the hospital:

Heart.—No enlargement, regular, no murmurs heard.

Lungs.—Normal expansion, no râles, dulness, or adventitious sounds.

Temperature, 98.6° F.; pulse, 80; respiration, 22. Blood-pressure, 140/110.

Urine Examination.—Normal.

There is a scar from the appendicular operation and a scar from the section. The enlargement is that of a seven-month pregnancy. The tumor is large, solid, and seems to be more to the right side than to the left; it is exceptionally elongated.

On vaginal examination I am quite sure that I can push the tumor up, although it does not fluctuate. I am quite sure, also, that I can map out the body of the uterus, so that it has got to be either a multilocular cyst under tension or some other cyst. When I say some other cyst I have in mind a case I operated upon about one year ago, in which we removed a large tumor from the pelvis which we could not dislocate at first, and even after the patient was put in the Trendelenburg position we could not dislocate it. As soon as we opened the abdomen the tumor disappeared entirely from sight; there was no question of fluid or anything of that sort. I put my hand in the abdomen and found it up under the costal arch, retroperitoneal, and that it involved the pancreas—a pancreatic cyst. That is the reason why I say some other cyst or tumor.

You see that this abdomen looks like a pregnancy of fully six months, almost seven, and the mass is more on the right than the left, and the way it rises above the umbilicus. The abdomen was shaved last night and is now being prepared by the application of iodin ($3\frac{1}{2}$ per cent.). Here is the scar of the appendix operation, and here the scar of her previous uterine operation, and I believe that we will find considerable adhesions; if we do not we will be agreeably disappointed. I am making an incision through the midline disregarding the old incision, and I make a liberal incision for several reasons. If this is a cyst, the possibility of its being malignant is very sure, and to rupture a malignancy in these days is not surgery. It will be far better to make the incision deliberately long and not run the risk of spreading the process of the growth, if one is present. Papilloma of the ovary may be highly malignant, and, again, of semi-malignant character, but the tendency is to be malignant. This is a multilocular cyst and possibly a cystopapilloma. Note the multiloculations. So far we are fortunate in not having adhesions, and the cyst delivers easily. That is something for an artist—with the full twist of the pedicle from the right to left. As a rule, these cystopapillomata of the ovary are bilateral.

This patient has nothing but a small fragment of the ovary here, the remains evidently from the former operation. There is no information concerning that fragment, but you will also see here at practically the midpoint a small band of adhesions, where there evidently was an operation for ventral fixation.

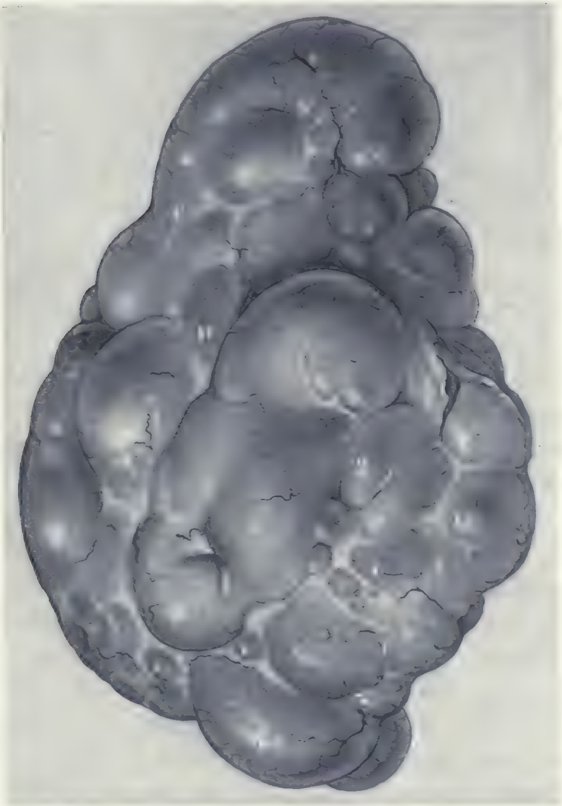


Fig. 114.—Case II. Multilocular cyst. Cystopapillomatous ovary.

After releasing the twist in the pedicle we clamp across below the twisted area and cut the cyst free. Now, instead of tying this pedicle off *en masse*, we sew over the forceps with a non-lock stitch, not drawing the suture tightly, but firmly. When we come to the end we release the thread and then quickly draw the slack in our suture. Then we retie it in case there is any bleeding.

I would like to call your attention to the attenuation of that fixation, how it has failed by a process of time. It forces the uterus into the position from which it was originally intended to separate it. This failure is due in part to the pressure from the large tumor above down upon the uterus. I think with the tumor out there is no need of shortening that in any way. The uterus appears to be normal. The appendix has been removed with inversion, no stump remains. The gall-bladder is normal.

For closure of the peritoneum I am using a No. 2 iodinized catgut, and I will run back with this to draw the muscles together. Then with a No. 2 chromic catgut, single strand, I will close the fascia. One silkworm-gut stitch for retention, and silk for the skin, using a lock stitch.

The patient has received little or no shock from this operation. The pulse is now 105, regular, and of good quality.

The anesthetic has been gas for induction, followed by ether, closed method. There was no preliminary injection of morphin in this case, and you see the anesthetic could not have been smoother. I use morphin as a preliminary to anesthesia only in goiters and cases for gas anesthesia.

This patient will be given morphin, grain $\frac{1}{6}$, as soon as signs of consciousness appear, and grain $\frac{1}{8}$ thereafter as often as necessary for the next thirty-six hours. Fluids by mouth, preferably tap-water, after six hours. Soft diet after eighteen hours if there is no vomiting. Enema for distention p. r. n., and catharsis as soon as needed after thirty-six hours. Unless the patient runs a temperature that cannot be accounted for, has pain in or a discharge from this wound, the dressing will not be disturbed for nine days. Then the sutures will be removed, and with primary union the wound will be inspected on day of discharge. She will be allowed to sit up on the ninth day, get out of bed on the tenth, and go home on the twelfth day.

I shall not be a bit surprised if the laboratory reports that specimen as malignant. If it is malignant the prognosis is absolutely good, for there is nothing in the pedicle at all. In cases of cystopapillomata of the ovary patients in many instances are prone to live for years.

It was in a case somewhat similar to this that the late Dr. Hodenpyl happened to be in the right position to remove the fluid, and the patient's improvement was so great that he thought something or other in the way of a serum that was autogenous from the patient might be of value to other cases. For some time subsequently he treated her with serum, and at the same time injected her serum into a number of other cancer cases, and, as is the case in all new remedies, these patients became buoyed up very much. They reported feeling better and he began to regard the cases of cancer as cured. Then, after a time, the reports began to come in that the serum was not a success. Just about that time Dr. Hodenpyl was taken ill, and when he received the news he was very much disheartened, and I feel his death was hurried by the disheartening news of his supposed cure.

I recall a patient with bilateral cystopapilloma operated upon at Mt. Sinai Hospital; six months later the patient was suffering so severely that something had to be done. We brought her down here and removed a cystopapilloma fully the size of a cocoanut from each side. That was five years ago and she is still well.

There are other types of cystopapilloma which are exceedingly vicious. I remember one case of a woman thirty-six years of age in the Roosevelt Hospital. She had bilateral cystopapillomata, and each one was about the size of a large grapefruit. She oozed serum as though she had been cut, and was bleeding so that it was impossible to keep the bed clean. We had put some drainage into her over night, and by the next evening the woman was practically exsanguinated from loss of serum. She died at the end of the fourth day.

Then we had a woman thirty-eight years of age who had a ruptured ovarian cyst which was a cystopapilloma, in whom I did an operation for intestinal obstruction, and found a mass of fluid, a large capsule, and a cyst. Eight months afterward she had a secondary deposit along the line of the incision. She died within a period of sixteen months from the time of the rupture of the cyst.

A few years ago I removed a cystopapilloma from a woman sixty-four years of age, and eight years after that she had a cystopapillomatous secondary growth in the scar of the abdominal wall, which demonstrates the length of time a patient can go without secondaries, and even if they do have secondaries, they may be mild in character.

Pathologic Examination.—*Gross.*—Cyst measures 25 x 20 x 10 cm. and weighs 2300 grams. It is thin walled, translucent, and lobulated by numerous constricting bands on its surface, which is generally smooth. On section, it is multilocular, most of the spaces being filled with a thin orange-yellow fluid, but in some it is relatively thicker and stringy. There are no papillary areas found. The inner surface is pale and smooth everywhere.

Microscopic.—Sections of cyst wall show a smooth outer surface with a wall of fibrous tissue and many irregular septa extending inward, interlacing and enclosing the cystic spaces. Some of the cysts are lined by a single layer of columnar cells, others by flattened cells. The septa contain blood-vessels and are somewhat infiltrated by round cells. There is no proliferation of epithelium at any point.

Diagnosis.—Multilocular cystadenoma of ovary.

The patient made an uneventful recovery, wound healed by primary union, and she left the hospital relieved of all symptoms except moderate constipation.

DUODENAL ULCER

This case is one of suspected duodenal ulcer. The patient has had pain in the abdomen for ten years, varying in time and intensity. The periods in which he is well are longer than the periods in which he is ill. That is one of the usual symptoms in cases of this kind. They have periods from six weeks to four or five months, or longer, in which they are well. The distress is from three to four hours after eating, varying in character, and accompanied by gas. He has been put on bicarbonate of soda to relieve the burning and gas. There is no vomiting, except by induction, all of which is characteristic of duodenal ulcer. Recently this patient has found that practically any kind of diet upsets him, whereas formerly only certain foods would. One year ago a gastro-intestinal specialist had him *x*-ray and advised operation.

On February 26th an examination revealed a tenderness over the duodenal zone, and also over the zone of the appendix. Yesterday he had quite a bad period, so now without any further examination by the *x*-ray we are going to do an abdominal exploration.

We make the duodenal incision in the rectus muscle or else between the inner third and the outer two-thirds. We have made our dissection between the inner third and the outer two-thirds of the rectus. The man has a very large ulcer at the duodenum, and just a fractional amount of infiltration. There is considerable obstruction, as you will see. That is only one-third of the stomach which I have out. A gastro-enterostomy will be indicated here unless we can do a Horsley operation. Sometimes when we anesthetize patients the stomach distends, and it is quite necessary to get rid of the gas. In this man's stomach I would like to get rid of the gas before we do anything. Then we might very readily press down the stomach and we can very readily bring up the duodenum. The doctor says he was washed out before he came up, but there is evidently a great deal of acute dilatation, or he is taking in a great deal through the esophagus instead of through his lungs.

Now we have a collapsed stomach here, and here is the colon, and here let me show you the prettiest ulcer that has ever been shown in this room. Note the infiltrated area with indentations, and note the vein showing the position of the pyloric sphincter. Now in this ulcer the entire diameter is less than the end of the little finger. This is the type of duodenal ulcer and complications in which we get the best results by doing a gastro-enterostomy. We have an obstructed condition and all we need is to do a gastro-enterostomy. Take and throw over the transverse colon, and we will then obtain a very easy dislocation of the stomach into this opening I am making in the transverse mesocolon. We dislocate the stomach and grasp it with a pair of forceps in the lowermost portion, although it is the highest portion of the stomach as we see it here. We are going to clean off these adhesions, and then by making tension on your transverse colon you will observe at this point the ligament of Treitz, and to the left of it that we have a fixed portion of the duodenum. We will make an anastomosis between the first portion of the jejunum and the stomach from left to right. The next step is to place your transverse colon into the abdominal cavity, and bring up the stomach. Cover up the field well with pads moistened with saline. Then we take Kocher clamps and grasp the stomach and intestine. Wall off everything very carefully with sponges, and then we begin our anastomosis by sewing the apposed surfaces of the stomach and intestine together with chromicized catgut. The primary stitch is the ordinary basting stitch. There is nothing fancy about this stitch; at least no fancy stitch is necessary. Neither do I make it my particular aim not to sew through the stomach and intestine. People do not die of infection in this operation. They die of pneumonia more than anything else, unless the operation is a bad one. When you come to one end of it wrap the needle twice, and that gives you a knot or a half-knot in your stitch.

Next we cut the opening into the stomach and the opening into the intestine, going about $\frac{1}{4}$ inch from the point of anastomosis or suture. Now to give you the picture to show you what we have, I will pick up the apposed surfaces of the intestine and stomach at this point. There we have an opening of about $2\frac{1}{2}$ inches in length; here is the mucous membrane of the outer wall of the intestine; here is the mucous membrane of the upper or anterior wall of the stomach. The appendix lays well down over the promontory against the sacrum and is bound down very badly. As long as we have it we will remove it, because the appendix is in itself a gastric disturber, and is said to be the cause, by means of infection, in many instances, both of gall-bladder disease and duodenal and stomach disturbances. I crush the base in every instance that I can in order to obviate the possibility of hemorrhage which results from turning in an open appendix. I am in the habit of crushing and ligating to obviate trouble of that sort. You place a purse-string suture $\frac{1}{4}$ inch from the base of the appendix, bathe the cut stump with pure carbolic acid, and invert it.

Here we have had a large ulcer of the pylorus, and have done a gastro-enterostomy from left to right, and found a chronic appendix which we have removed. This man's treatment will be $\frac{1}{6}$ grain morphin, Fowler position, a Murphy drip of 1000 c.c. containing $1\frac{1}{2}$ ounces of glucose and bicarbonate of soda. He will have nothing by mouth for twenty-four hours. If he vomits he will be washed out. Should the pulse begin to climb very fast within a few hours we will know that there is hemorrhage. We have had hemorrhage from this operation about five times within fifteen years.

The abdomen will be closed with plain No. 2 for the peritoneum and muscles and chromic No. 2 for the fascia. No drainage used.

The patient made a good recovery, no vomiting after operation. Left the hospital able to take all foods except heavy meats with no gastric discomfort.

Pathologic examination of the appendix shows chronic appendicitis.

CHRONIC SUPPURATIVE MASTITIS

The next case is that of a woman forty-four years of age who has had a discharging breast for the last two years, and during which time she states she has had thirty-two abscesses. You will see she has a sinus at this point. There are no glands in the axilla and no reason to believe that there is any malignancy, except from induration, which it is possible to get in septic mastitis, which she has evidently had. Her last child was born two years ago and she had no milk in the right breast; the child nursed only from the left. Two years ago the right breast swelled without discharge for a time, but since then she has had seventeen abscesses in this breast, which were cut. Two days ago it swelled up again, the patient had chills and fever for a time, and then the breast began to discharge. In these mastitis cases occasionally the breast must be amputated, although that is rare. Every now and then we find a case which has come to the point where amputation must be considered, and then excision of the breast will cure it. Three years ago I had a case with a number of abscesses actively discharging, and the only thing we could do was to remove the entire breast. In some instances the cases are cured after a liberal dissection within two and a half to three weeks. This patient does not present a picture of seventeen abscesses. There are only two scars, but possibly there may be a foreign body left in with one or both of these.

We will not do a radical operation, but will simply lift the breast from the pectoral muscles, unless the tissue looks malignant. It does not feel so. We will remove this breast with the Stewart incision, which begins at the median line or beyond the median line, extending it across the posterior middle portion of the axilla, and we will do a very rapid dissection. I will make the incision in the breast. There is a sinus at that point, and something that looks like more pus here. Under ordinary circumstances I would think it was malignant, but there is nothing at all that looks anything like malignancy. There is absolutely nothing in the glands. But we have a suppurative mastitis which would never have gotten well without excision of the sinus itself or excision of the breast. We put in a $\frac{1}{4}$-inch caliber rubber drainage-tube, and put in three silkworm sutures, and then sew it up with silk.

This incision of Stewart's is used in removal of the breast in a radical operation, just as well as it is in operations of this kind. I have personally done over 100 operations in malignancy and non-malignancy using this incision. In the first 25 there were a large number that complained of exceptional pain in the axilla. Whether we were just anxious about the patients and recorded pain more frequently I do not know. But after the first 25 the patients did not seem to be complaining of much pain, at least not as much as in the first 25. The incision is all right for certain locations of the tumor. After that the modified incision of Meyer and Halstead or the incision of Rodman will give better exposure, more than does the incision of Stewart. I would rather do a Willy Meyer-Halstead operation than this type.

Pathologic Examination of the Tissue.—*Microscopic.*—Sections from three areas show the same picture. There is degenerating fibrous tissue heavily infiltrated by polynuclear cells. The exudate is so extensive that recognition of fixed tissue cells is difficult. There is extensive proliferation of endothelial cells. No mammary gland tissue is seen in the sections.

Diagnosis.—Chronic purulent mastitis.

Discharged to the out-patient department on fourteenth day with considerable seropurulent discharge.

CHRONIC CHOLECYSTITIS

The next patient is a woman thirty-six years of age, with pain in both sides—right high up, left lower down. Also backache and pain in abdomen during the night, usually about 2 o'clock in the morning. Has never had pain of great intensity while awake. The pain is usually worse in the evening between 5 and 7 o'clock than during the day, but she is bothered much more in the night time. There has been no vomiting. Examination shows patient to be markedly tender over the gall-bladder and appendix, and there is a retroposition of the uterus, with slight ulcers of the cervix. I am going to expose her for an appendix and an exploratory gall-bladder at the same time.

In this case there is a possibility of finding a diseased gall-bladder or appendix, or both, and instead of making the incision for a gall-bladder or appendix, we make it between the two points, that is, a low gall-bladder incision or high appendix incision, which will allow us to go up or down as the condition demands. In other words, if we see that the gall-bladder is involved, we can extend the incision upward, and if it is the appendix we can extend our incision downward. We will make it in the midportion of the rectus. That will give a free entrance to the gall-bladder for palpating or visualizing, and also for palpating or visualizing the appendix. We will make a Deaver incision. The first thing we do is to examine the gall-bladder. It is normal, white, and I do not find any evidence of stones. Unless there are adhesions to the gall-bladder I am not going to take it out, so that we will extend our incision upward until we can see the gall-bladder. It is a peculiar pearly gray and has not the appearance of a normal glistening gall-bladder. We have the appendix low down in the pelvis. It is pathologically pink and white, and there are some bands and adhesions also at this point. The first step is to release the adhesions, which are dense in this case. Now I will do a routine appendectomy, just as you saw me do in the other cases.

Coming back to the gall-bladder, we will now proceed to wall off the abdomen with moist pads, so that we can do a cholecystectomy.

I remove this gall-bladder because of the peculiar pearly gray appearance, which is decidedly abnormal, and the definite history of past gall-bladder attacks. Although there is no evidence of stones here nor has there been any symptoms in this case of involvement of the gall-ducts by stones, I believe the pathologist will report a diseased condition of this mucous membrane, and there is one operation for uncomplicated cholecystitis in this clinic—cholecystectomy. We are getting away from the "Stone Age" in the surgery of the gall-bladder and coming to depend more upon the appearance, adhesions, and glandular enlargement about the cystic duct for information regarding the past inflammation and future history. The effect upon the biliary system from removal of the gall-bladder is still unsettled experimentally, but we have known for years that removal produces no subjective symptoms.

With a clamp on the fundus of the gall-bladder it may be used as a tractor to dislocate the liver, giving free exposure of the cystic duct region. Grasping the hepaticoduodenal ligament between thumb and index-finger of the left hand, with the gall-bladder resting in the palm, a longitudinal split is made in the ligament, the peritoneal edges separated, and the cystic duct dissected free, using the index-finger as a guide. By forcing the scissors through the ligament above the duct it is clearly demonstrated to be free, and as the scissors are withdrawn a clamp follows; another clamp is applied above and the duct cut across. Using the clamp across the duct as a tractor, the artery and vein are dissected free and clamped. Now as I dissect the gall-bladder free from the sulcus my assistant will clamp the blood-vessels as they appear in the peritoneal reflection. The first ligature is applied to the duct, No. 2 iodinized catgut, and now from below up we will tie off the branches as they were clamped.

In the majority of cholecystectomies I place a drain of rubber tissue down to the cystic duct, removing it at the end of thirty-six hours. There is no need of a drain in these cases for infection, but every now and then we see drainage of bile from a ligature slipping, and to save reopening the abdomen in these occasional cases we usually place a small drain in the upper angle. The drain does not interfere with the healing of the sound, as it is removed in thirty-six hours.

Wound healed by primary union; patient left the hospital on fourteenth day.

Pathologic Examination of Gall-bladder.—*Microscopic.*—Sections of gall-bladder show low rugæ in part, with tips of rugæ stained with bile and some hyperplasia at base of glands, with mucus in the crypts. The stroma is infiltrated by round cells and a few polynuclears. There is increase of fibrous tissue between the muscle bundles and beneath the serosa with round cells, and polynuclears in excess in the blood-vessels throughout.

Diagnosis.—Chronic cholecystitis and pericholecystitis.

CLINIC OF DR. WILLY MEYER

Lenox Hill Hospital

THE IMPORTANCE OF POSTURE IN POSTOPERATIVE TREATMENT

When as a young student in medicine I attended the lectures of the late well-known Professor Zenker of the University of Erlangen in the winter of 1877–78, he closed the season's last address to his class with the words: "Remember, gentlemen, prophylaxis, the prevention of disease, is the highest aim of medicine." These words were indelibly engraved upon my memory. During my entire medical life I have watched with the keenest pleasure the evolution of medicine and surgery from this point of view, and have followed with the highest admiration the incessant, often self-sacrificing work of medical men to prevent disease in all the branches of our science. I have also personally tried to do my little mite whenever and wherever possible and to live up to my esteemed teacher's impressive words.

What has been accomplished in the way of prevention of disease is known to all of us and to the world. I will but remind you of Jenner's immortal achievement, the vaccination against small-pox, and the now uniformly introduced successful inoculation against typhoid fever, diphtheria, cholera, even yellow fever, and many other infectious diseases, of which the infecting microbe has been found and cultured. So the entire apparatus set in motion everywhere, in private practice and hospital work, before and during operation, all of what we call antiseptic and aseptic surgery, is nothing but a detailed and determined attempt, founded on definite scientific knowledge, to prevent disease, to render infection impossible.

Now, just as our endeavors in surgery, *pre*-operatively as well as *during* the operation, are important to prevent disease and complicating affections, so must our endeavors be constant *after* the operation, when the patient is being and has been returned to his bed, when after-treatment has begun.

Of the many important factors that here come into consideration I shall at this time pick out just one—"posture." Posture in all its varieties is, to my mind, one of the most powerful means at our command to hasten recovery and avoid complications. Of the various postures introduced into practice I shall this evening consider principally two, which I have practised for a great number of years in hospital and private work, alone as well as combined with others—the slight Trendelenburg posture and Sims' posture, or the latter more exaggerated, the abdominal posture.

The Slight Trendelenburg Posture.—When a patient has successfully gone through the immediate dangers of the operation and the first part of the after-treatment, and he as well as all the others concerned in his welfare feel easy and are looking forward to a speedy and uninterrupted recovery, there is still one treacherous enemy lurking in the background ready to strike at any moment—venous thrombosis.

This thrombosis usually concerns the left femoral vein, following work done by the surgeon in his every-day routine, also one or more of the pelvic veins after operations on organs within the small pelvis and after childbirth.

From a pathologic point of view such blocking of the venous lumen is not a very serious matter. The lower extremities and the respective pelvic organs easily stand the disturbance in the normal return flow of the blood to the inferior vena cava. Collateral circulation is plentiful and the concomitant edema of the extremity—though usually at first greatly alarming the patient and his relatives—subsides after a certain time. Its persistence is very rare. Surgeons are used to ligating the deep femoral vein, for instance, in the operative treatment of the so-called thrombo-angiitis obliterans, and no interference with the ordinary circulation is seen. With aseptic healing a thrombus forms immediately adjacent to the ligature and usually extends up to the spot where a lateral branch enters the ligated vein. In phlebitis the coagulation does not remain quite as local. The thrombosis forms as far as the venous wall has become inflamed and more or less edema develops in the lower extremity, at least, if the femoral vein is involved. Thrombosis in branches of the internal iliac vein may run on without any external manifestations; an unexplainable tachycardia is taken by many as the only outward sign. If the inflammation spreads to the external branch of the common iliac vein, edema of the leg and thigh may become alarming. I but remind you of the so-called phlegmasia alba dolens after complicated childbirth.

What medical men fear is the clinical sequelæ of the thrombosis: the loosening of a part or of the whole length of the thrombus, which then enters the circulation and is driven as a foreign body through the right heart into the lung. What we fear is this sudden pulmonary embolism, the sudden interruption of the normal physiologic circulation of the blood between the right and the left heart by way of the lung, partially or completely, which sets in like a flash from the blue sky and is absolutely beyond the control of the attending physician.

I spoke before of the thrombosis of the left femoral vein. Why only of the left and not also of the right?

It is a clinical fact that at least 95 per cent. (if not 99 per cent.) of thromboses of the femoral vein occur on the left side; and if both veins become involved, one after the other, that the trouble almost always starts with the left. The reasons for this peculiarity are principally anatomic.

We know from the investigations of the Freiburg pathologist, Ludwig Aschoff,[1] that thrombosis occurs in those portions of the venous system in which the flow of blood is retarded provided micro-organisms circulate within the blood.

With the patient in the usual horizontal posture in bed after an operation, the upper part of the body from the hips up being supported on pillows, there is no place in the body where venous circulation is more impeded than in the groin. Poupart's ligament, often strained, presses upon the femoral vein as it runs across the horizontal branch of the pubic bone. From here on the blood has to run uphill in order to reach the inferior vena cava. Further up, on the left side, the right common iliac artery or the lowest portion of the abdominal aorta crosses the common iliac vein in front of the spine, whereas on the right side the external iliac vein passes underneath the external iliac artery, a much smaller vessel, in order to reach the common iliac vein and inferior vena cava. Here also the soft belly of the psoas muscle forms the pillow on which these vessels run. The difference in the circulatory arrangement of the right and left sides is due to the anatomic fact that the inferior vena cava runs

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[1] Aschoff, von Beck, de la Camp, Kroenig, Beiträge zur Thorombosefrage, Leipzig, 1912.

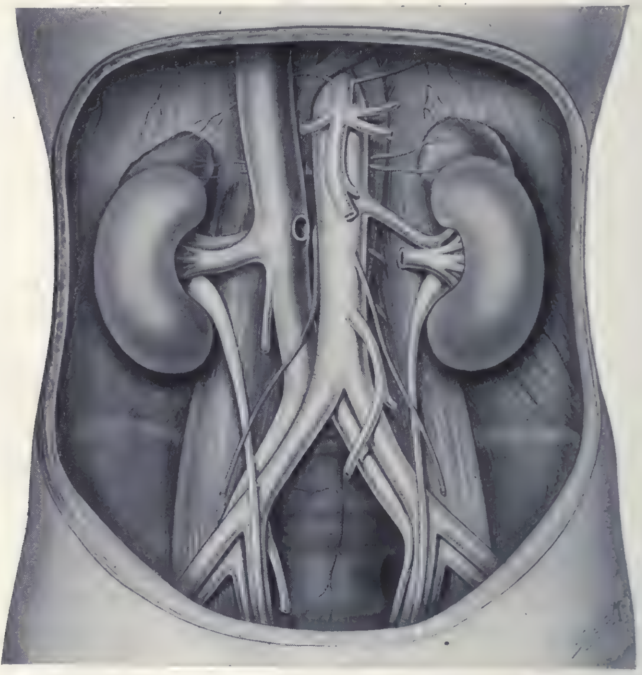

Fig. 115.—The anatomic relation of the crossing of the left and right iliac veins and arteries. (From Heitzmann's Anatomy.)

nearer to the median line than the abdominal aorta (Fig. 115). Further, before the common iliac vein reaches the place where it has to pass under the strong and ever-pulsating common iliac artery, the sigmoid flexure of the colon, usually filled with inspissated fecal matter, rests upon it for quite some distance.

These factors have been accused as being principally responsible for the clinical fact that postoperative femoral thrombosis is almost exclusively met with on the left side. It is, of course, possible that in addition to these anatomic conditions minor factors often come into play in its development. Repeatedly I have been asked, when speaking on this subject before my assistants and students, why has not this complication been seen more frequently in medical cases which have been helpless and bedridden for many months, why principally in patients that have been operated upon? My reply has been that the ordeal, which we call operation, opens up a great many ports of entry through which microbes may reach the circulating blood current. It takes time, likely a few weeks, before the slowly recuperating system gets rid of them. Usually it is the second week after operation in which the thrombosis of the femoral vein occurs.

Besides, the effect of the general anesthesia may contribute to thrombus formation. It will be interesting to watch and observe, whether regional and local anesthesia, employed nowa-days in so many major and minor operations, will reduce its occurrence.

Weakness of the heart muscle is also to be considered in the etiology of thrombus formation.

Fortunately, femoral as well as pelvic thrombosis, as such, is rare. Yet, I am sure, every somewhat busy surgeon has met with it. And whoever has gone through the worry and annoyances it has produced, particularly in private practice, will never forget it. Very vividly stands before my memory an experience of one of the first years of my surgical practice. I had been called to operate upon a case of acute appendicitis in a private residence, and had to go ahead at midnight. The patient was the only daughter, in fact, the only child in the family. Everything went well at first, and in the beginning of the second week, when asked again concerning the prognosis, I expressed myself as very sanguine and extended the hope that the patient would be out of bed a few days later. During the following night she complained of pain in the left groin, which increased from hour to hour, in spite of an ice-bag immediately applied. Soon the leg began to swell, and a typical femoral thrombosis developed. Not long after the femoral vein on the right side followed suit. It was more than six weeks later before I dared to allow the patient to be out of bed. The people I had to deal with were very nice; still, I sometimes felt that they blamed me for the complication.

On looking back, several cases of thrombosis re-enter my mind which occurred during the first two decades of my forty years of continuous surgical practice. I have seen it after the most aseptic surgical interferences as well as after operations for acute intra-abdominal inflammations. I have seen left femoral thrombosis set in after an operation for hernia, after the radical operation for cancer of the breast, also subsequent to operations for acute appendicitis and perityphlitic abscess, following suprapubic cystotomy, etc. Never can I forget when the father of a well-known colleague here in New York, after a suprapubic lithotomy done by me at his home, developed a left femoral phlebitis which evidently gradually extended farther up into the iliac vein. It was many weeks before the pronounced swelling of the lower extremity began to recede somewhat. A marked difference in the size of the two lower extremities persisted; he had to wear a rubber stocking that reached almost up to his hip and required special suspenders to prevent it from slipping down, a procedure which proved to be a great hardship for the patient. Barely two years later he died suddenly with symptoms of a pulmonary embolus.

On one occasion when I was visiting a semiprivate patient of mine at the hospital I saw his roommate, who had been operated upon by one of my colleagues for a stone in the kidney, drop dead upon his first attempt to walk to the window of the room. Naturally, all concerned in the case were utterly distressed. Autopsy showed an embolus riding on the bifurcation of the pulmonary artery.

I could cite other cases of the same type, as vivid in my memory as if they had occurred today. The fact that I have also seen patients with a pulmonary embolism recover under my hands might be worth mentioning, but does not fit in the realm of the present discussion.

So much is sure, and I wish to repeat it, whoever has met with this complication in practice, striking as it does so suddenly and with unexpected deadliness later on after operations, when the patient may be up and about again and ready to leave the hospital, or sick room, will never forget it.

No wonder that it has excited the interest of many medical men! No wonder that it has been thoroughly investigated and frequently discussed! I myself wrote a brief paper on the subject twenty years ago,[1] and have always tried my utmost to prevent its occurrence in my patients.

Can it be prevented? Yes. I believe it can, perhaps not absolutely, but surely reduced almost to a minimum.

It stands to reason that if we can overcome the normal anatomic impediment in the circulation of the lower extremity at Poupart's ligament and further up in the pelvis, the principal cause for the formation of a phlebitis and therewith of a thrombosis would be successfully met. This we are able to do. Just as we allow our automobile to run faster before we approach a hill right ahead of us, and then see it climb up, usually without changing the gear, in the same way we can make the blood current in the femoral veins faster, and thereby for the blood the ascent from the lower extremities to the right heart easier *if we raise the lower end of the bed,* that is to say, if we arrange for a slight degree of Trendelenburg's posture (Figs. 116, 117). Blocks placed under the foot end of the bed[2] (Fig. 118) will allow the blood within the lower limbs to run "down hill" from the toes to the hips, and in its onrush it will easily reach the veins in the upper pelvis, nay, I am sure, often the region of the renal veins, from where the negative pressure existing in the thorax, the suction of the right heart, will substitute the decreasing velocity of the blood current.

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[1] Rare Complications After Operations for Appendicitis. Read before the New York Surgical Society, April 11, 1900, Annals of Surgery, May, 1901.

[2] At the Lemon Hill Hospital, New York, four different sizes of blocks and "steps" are in use for obtaining the posture desired for the given case.

I am absolutely convinced that this simple means of raising the lower end of the bed is the most powerful weapon we possess of preventing the occurrence of femoral (and pelvic) thrombosis. I am using it after every case of operation at or below the level of the heart, in weak patients also after operations on neck and head, if they stay in bed for some time, and can truthfully say that I have not seen the typical thrombosis of the left femoral vein occur since I started doing this. In my paper on this subject, already alluded to, I mentioned that "it would be interesting indeed if experience would show that by such raising of the

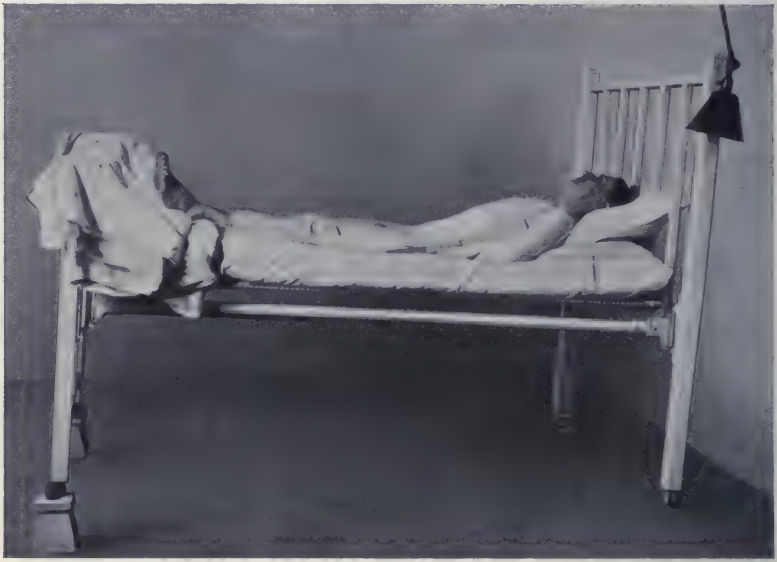

Fig. 116.—Slight Trendelenburg posture, with patient on his back, resting. This is the standard posture for all patients operated upon below the level of the heart; also for weak patients, operated upon head or neck, who cannot get up early.

lower end of the bed the occurrence of femoral thrombosis could really be prevented; that is to say, if we found that the complication occurred only in such cases where this prophylactic measure was omitted." Today I can state that this proof has been rendered.

Last year, for the first time in many years, after a cholecystectomy, I saw a patient already out of bed two weeks after operation, suddenly and unexpectedly die under the unmistakable clinical symptoms of pulmonary embolism. She had made a smooth recovery, except for pronounced postoperative vomiting, and had been treated as usual with elevation of the lower end of the bed. Unfortunately, the family would not allow an autopsy, much as I tried to get permission for it. Therefore I cannot prove the correctness of the diagnosed cause of death. Still, the tragic suddenness of the exitus in the midst of seeming well-being and the immediate marked paleness of the face spoke

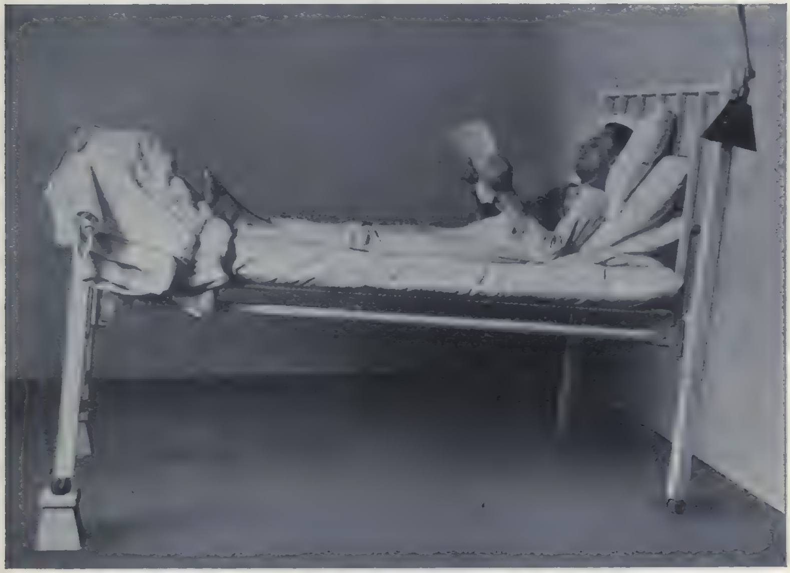

Fig. 117.—Same posture, with patient awake, his attention being engaged otherwise. There is no reason why the upper part of the body should not be raised on pillows at the patient's convenience.

for it. The patient had had a number of children and may have harbored in her pelvic veins a thrombus for many years. She had not developed a femoral thrombosis during the after-treatment.

I would like to cite another case illustrating how a prolonged Fowler's posture can favor femoral thrombosis. As will be mentioned later on, I am in the habit of treating my patients with resection of the stomach and gastro-enterostomy with a slight Fowler's posture during the first few days after operation. A lady of forty, in whom I had resected a cancer of the stomach that had developed on the basis of an old ulceration according to Billroth's operation No. 2, liked the posture very much, and begged to remain in it longer than the usually allowed three days. Just at that time I had to leave town for a few days, and

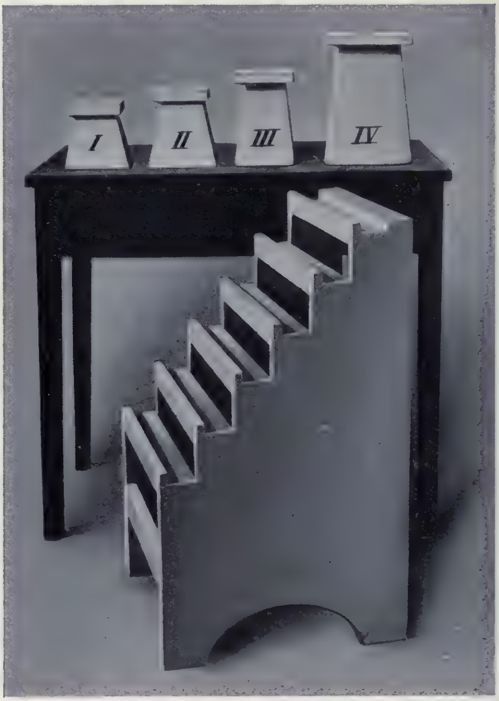

Fig. 118.—The four sizes of blocks and "the steps," as used for elevation of head or foot end of the bed at the Lenox Hill Hospital, New York. The height of the blocks is respectively 5, 6, 7, and 10 inches.

thus it occurred that she had the head end of the bed raised on blocks for ten days. At about that time she began to complain of pains in the groin and tenderness over the left femoral vein. She soon also developed some edema of the extremity. Of course, the position of the bed was quickly changed, but the annoying symptoms of the femoral thrombosis lasted longer than any other sequelæ of the operation.[1]

I would also like to mention an observation recently made in 2 patients, one after posterior gastro-enterostomy for duodenal ulcer, the other after an operation for a gangrenous appendix. In both cases a painful swelling occurred in the soft parts of the left leg, accompanied by fever and tenderness over the calf, which developed two to three weeks after the operation, and could not be diagnosed otherwise than representing a deep-seated localized phlebitis between the muscles of the calf. In both the lower end of the bed had been elevated continuously since right after the operation. Both patients got well after about two to three weeks without any further untoward symptoms.

A third case of the same type I saw recently in the practice of another colleague. He, too, got well.

The favorable preventive effect of "posture" has for many years been methodically assisted in every one of my operative patients by frequent motions, particularly of the left lower limb—I call it "bicycle riding in bed"—and by deep and frequent breathing exercises during the first one to two weeks after the operation. This latter addition I consider particularly important.

As stated already, it is possible that other factors may play a rôle in the development of venous thrombosis besides the usual horizontal posture of the patient in bed, for instance, the anesthetic. It is a fact that in some patients the expiratory air still smells of ether or anesthol on the second or even the third day after the operation. It stands to reason that the elimination of the anesthetic from the system by way of the blood in the lungs will occur more quickly if we insist on regular, slow, frequent, and deep breathing exercises immediately after operation and also later on. In the first days the anesthetic will thus leave the system faster; later on, the methodic breathing, done principally under the supervision of the attending nurse, may prevent pneumonia, particularly in the old. None of us ventilate our lungs sufficiently. The reason is that we have too much lung—five lobes. The exchange of gases physiologically necessary to sustain life can well be sustained by superficial breathing. Were it not for an occasional sigh or a hearty sneeze many of us would not breathe deeply for months. Yet what a sensation of comfort and satisfaction is produced by a deep inspiration. Just think of our vacation time, gentlemen, when we stand on the deck of an ocean greyhound or float in a boat on one of the mountain lakes, how thoroughly every one enjoys the benefit of a deep inspiration! We should also enjoy it in the midst of our busy lives. Just pause and breathe deeply. There certainly will be less chance for atelectasis. By all means we all should make it a point to instruct our patients who have been operated upon to practice methodic deep breathing.

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[1] Many colleagues are inclined to order elevation of the affected extremity on pillows in such a case. Personally I do not consider such a treatment of femoral thrombosis as good or as effective as the elevation of the lower end of the bed.

In weak patients and also after severe intra-abdominal and intrathoracic work I have added for many years to the precautionary methods, already alluded to, a prophylactic subcutaneous stimulation of the heart muscle by means of camphor, caffein, digalen, or digifolin, etc., beginning methodically immediately after the operation and continued for a number of days. Later on the same medication by mouth is resorted to.

I certainly can truthfully affirm that femoral thrombosis is unknown in my division in the hospital and also in my private practice since the strict and methodic application of the just-mentioned procedures have been practised by me during the last twenty years.

Sims' Posture, Alone, and in Combination with Fowler's and Trendelenburg's Posture.—Gentlemen, I hope not to tire you if I still talk briefly of the most beneficial effect of another posture which I have been using in postoperative treatment of my patients for many years, that of Sims (Figs. 119, 120). Of the postures that are at our disposal, during and after operation, Sims' posture is surely one of the most useful I know of.

Personally, I believe that a case of acute gangrenous appendicitis, with its frequently present seropurulent or purulent effusion into the peritoneal cavity, fares best if the abdomen is drained with the help of Morris' cigarette drain, which carries a rubber tube in its center, or has an additional entire or lengthways split drainage-tube—I call the latter a gutter drain—attached outside. I put this drain into the lower end of the usually practised pararectal incision down to the bottom of the small pelvis and close the wound by layer sutures; I also place one or two stitches below the drain in the lower angle of the peritoneal, fascial, and skin wounds, so that after removal of

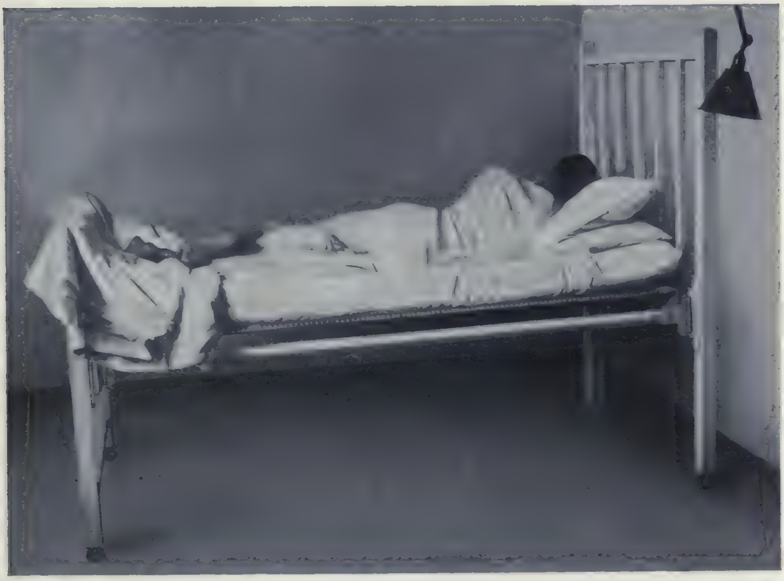

Fig. 119.—Typical Sims' posture, both arms of the patient pointing forward, while he rests principally on his right shoulder. His lower leg is kept straight, while the upper is flexed at hip and knee-joint, the latter touching the bed. It contributes to the patient's comfort to place a pillow crosswise between the knees.

the drain, mostly in the course of the third day after operation, the buttonhole in these tissues can easily close.

I am absolutely opposed to closing up the patient's abdomen after removal of the gall-bladder. I believe the surgeon has not the right to take chances with his patient's life for the mere pleasure of seeing the abdominal wound heal by primary union throughout or for the sake of simplifying the immediate after-treatment for the patient as well as for himself. One hundred consecutive patients with a cholecystectomy wound closed up air- and water-tight may recover smoothly; and the hundred and first may die for no other reason than that the abdomen was not drained, if the ligature on the stump of the cystic duct gave way and bile-containing microbes suddenly entered the closed peritoneal sac. I am furthermore of the opinion, so

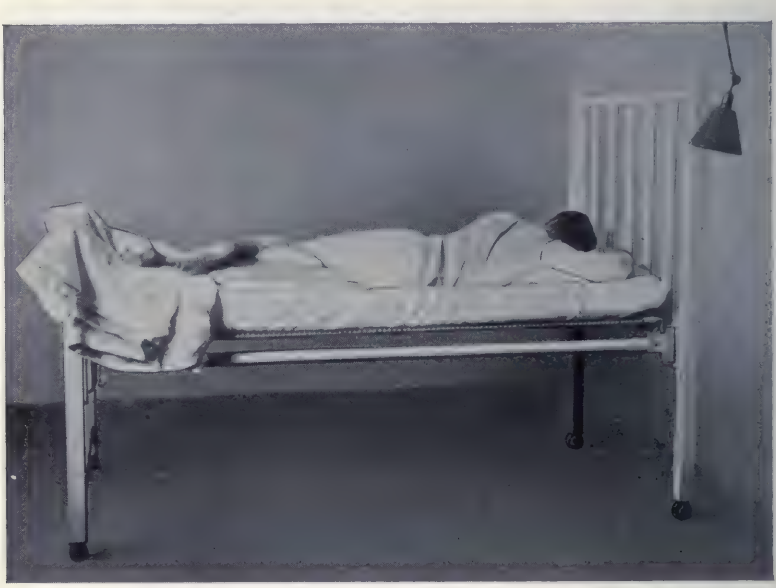

Fig. 120.—The same, with patient resting on the upper part of his chest and one arm more or less extended backward. This posture is less comfortable and is made use of exceptionally and for a short period only, should the patient get tired of the usual one. If the desirability of the lateral posture seems less pressing, he will be more satisfied, when tired, if allowed to be turned temporarily more on his back.

far as cholecystectomy is concerned, that it is for the best interests of the patient if we start the removal of the gall-bladder from the fundus toward the cystic duct and not in the opposite direction. Just look at the beautiful illustrations given to the profession by Eisendrath of Chicago, exhibiting the great variety of anatomic relation between the cystic artery and the bile-ducts, also the great variety in the course of the cystic duct with regard to the common. No one can foretell whether any one of the many anomalies is present in the case just at hand. A good exposure of the junction of the cystic and hepatic ducts will show clearly the fascinating anatomic relations; it will also permit the surgeon to place the ligature close to the common duct and thus render absolutely impossible the re-formation by nature of a smaller gall-bladder after cholecystectomy, which some surgeons claim to have observed. Starting the excision of the gall-bladder from the fundus usually means more bleeding in the gall-bladder bed. It is quickly and easily controlled—best, to my mind—by an aseptic gauze tampon, which during the operation is compressed by a blunt retractor held by the second assistant, and which later on, together with the cigarette drain, that is introduced down near to the ligated cystic stump, is surrounded by a piece of rubber-dam to prevent adhesions. These three items form my way of drainage after cholecystectomy.

If, now, we place the patient in Sims' posture immediately after he has reached the bed—or, better still, when he is lifted from the operating table on the stretcher to be removed from the operating room and wheeled back to his bed—the bottom of the small pelvis after an operation for perforative appendicitis and the cystic duct-stump after cholecystectomy is the highest point of the drainage system inaugurated and not the lowest. Blood-serum, wound secretion, often also bile from the gall-bladder bed or a leaking cystic stump, will now run down hill to the outside over the shortest route possible, not uphill. I insist on the continuance of this posture for the first eighteen to twenty hours, when a slight turning of the body to the left is permitted. On the third day after the operation the patient may permanently take the usual position on the back; that means at a time when the principal normal wound secretion has ceased. During these first few days the foot end of the bed is not raised because we all like to avoid having any wound secretions sag toward the subphrenic space from where absorption into the general circulation is favored. At the end of the third day the foot end of the bed is raised on blocks (Fig. 121).

It is my belief that by looking ahead and always considering "safety first" to be the solemn duty of the surgeon, the majority of the patients will do well under this treatment after cholecystectomy. The statistics of many individual men now-a-days show that of 100 patients with interval operation for appendicitis and also for acute appendicitis—the latter being done within the first twelve to eighteen hours after the onset of the attack—100 get well. Similarly we see of 100 cholecystectomies, 98 (if not 99) recover. A death is usually due to an accident. I believe that drainage aided by Sims' posture, and later on by a slight Trendelenburg posture, if generally adopted, would contribute to make such results universal.

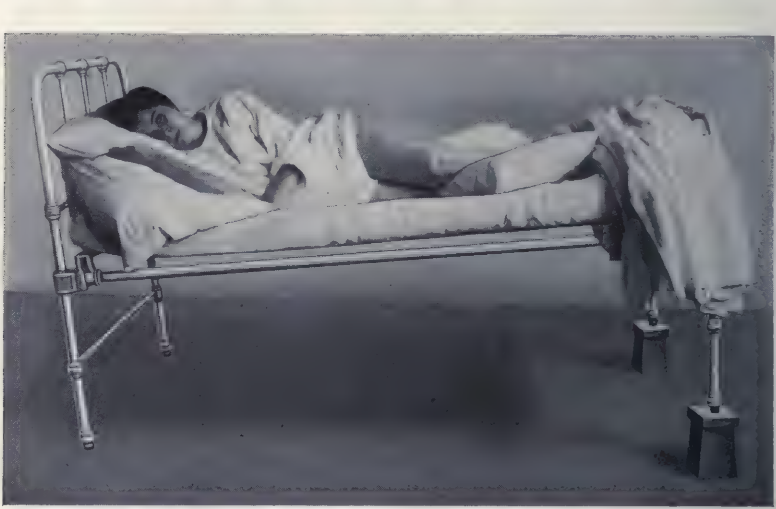

Fig. 121.—The same; front view. The patient is made to take this posture again for about two to three hours, when the various parts constituting drainage are removed in relays, commencing one week after operation.

I proceed in exactly the same way if, in addition to cholecystectomy, the hepatic or common duct is to be drained, or if gall-bladder and duct require drainage.

Another operation which in its immediate results is, I think, greatly benefited by Sims' posture is gastro-enterostomy. In posterior gastro-enterostomy I always join the short loop of the jenumum to the stomach in such a way that the current in both organs runs in the same direction. What is then more plausible immediately after a posterior gastro-enterostomy than to turn the patient into a not too exaggerated right Sims' posture and at the same time to slightly raise the head of the bed? (Fig. 122). I know from experience that the patients like this position. Although later on in the after-treatment I often repeat to them that they may well stay on the back, I find the majority of them favoring the right lateral posture. Certain it is, that I see very little if any vomiting after my gastro-enter-

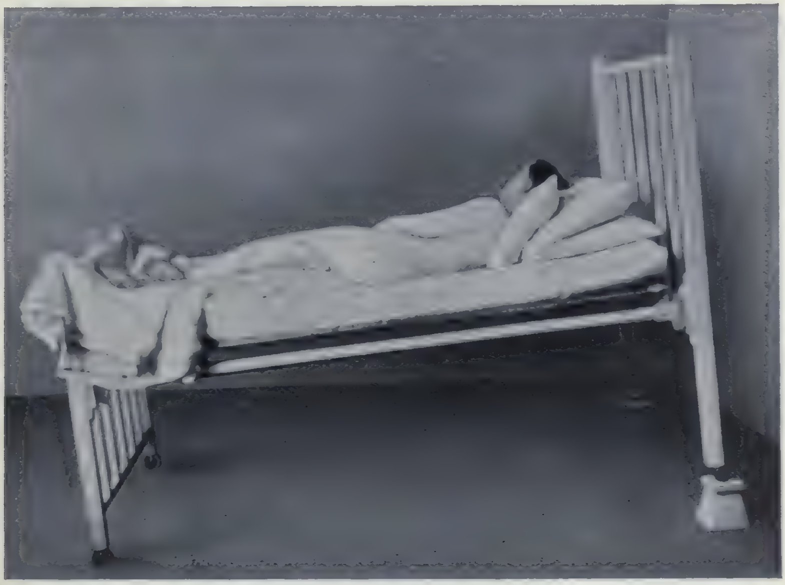

Fig. 122.—Sims' and slight Fowler's posture combined during the first three days after gastro-enterostomy.

ostomies. Whether or not this is partially due to the posture, I am not quite ready to decide, although I believe it is. An important contributing factor is that for years surgeons have practised the attaching of the stomach, and not of the jejunum, to the rent in the transverse mesocolon. The so-called and much dreaded "vicious circle" is no longer seen.

Remembering that a thrombosis of the left femoral vein—should it occur—makes its appearance not earlier than the second week following the operation, I never keep the head end of the bed on the blocks longer than up to the third day—at the utmost up to the fourth day—after the operation, the time peritoneal secretion ceases. The assistants and nurses know that by that time the blocks have to wander under the foot end of the bed (Fig. 123).

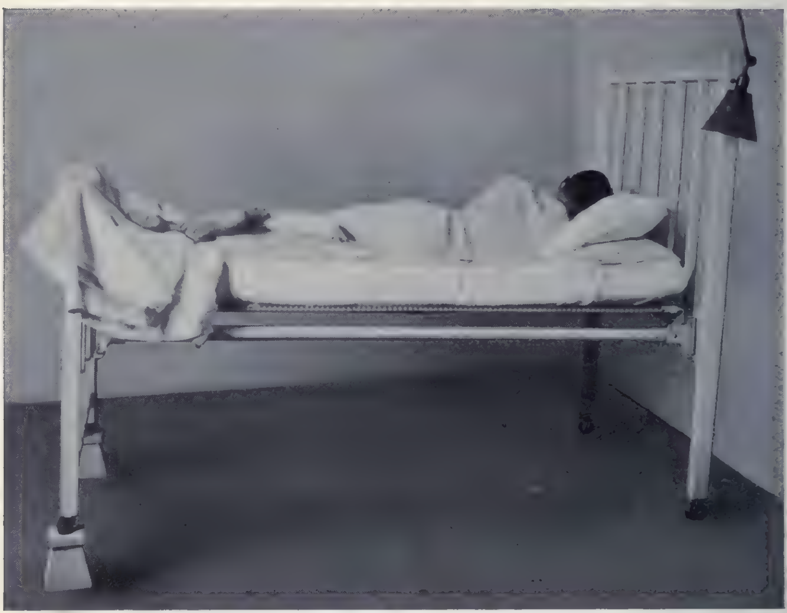

Fig. 123.—Sims' and slight Trendelenburg's posture combined, as used later on after gastro-enterostomy, the degree of lateral posture, as well as the raising of the upper part of the body being left to the patient's convenience.

I insist on continuing keeping the foot end of the bed raised until the patient gets up. As soon as he is allowed to be up and move about the blocks are removed and the normal horizontal position of the bed is resumed. I am never influenced by the requests of the patients to change these tactics. To questions of *why* I insist on the posture, I reply with the statement that I am willing to tell them when they are ready to leave the hospital. To many I have had to explain the "why" later on; others forget to ask about it again.

Only temporarily is it allowed to put the foot end of the bed down; that is, in those exceptional cases where some difficulty is experienced in urinating when the foot end of the bed is raised; often the same patients are also unable to void in the horizontal posture, but some certainly can easier relieve themselves if the bed is lowered. To allow the bladder to distend as much as possible I have always found to be a splendid policy. In my division we defer the postoperative use of the catheter as long as possible, especially with the male, without, however, being too hard on the patient. I cannot agree with those surgeons who demand catheterization if the patient has not voided within eight to ten hours after operation. Now and then we could well temporize until thirty to thirty-six hours after operation, when the patient urinated spontaneously, and then passed only 350 to 400 c.c. Why use a catheter for such a small quantity, which frequently did not bother the patient to carry in his bladder in the midst of well being! After all, catheterization, no matter how carefully and how aseptically done, means for the patient—at least for the male patient—an additional interference which if avoidable means another asset for him.

I have before mentioned Sims' posture combined with a slight Fowler's or Trendelenburg's posture. I am very much in favor of combining postures, and let the degree depend upon the amount of infection and extension of the intraperitoneal effusion. We all recognize the great service the late and much lamented John B. Murphy has done to suffering humanity with his systematic rectal instillation, the patient being in an exaggerated Fowler's posture, in cases of general septic peritonitis after intra-abdominal perforation of any sort. Special beds, very useful ones indeed, have been constructed to make this posture comfortable and practical. Usually we can get along with a simpler arrangement. In cases of this type, if we drain at the same time, I have for years been in the habit of combining Sims' with Fowler's posture. If the lower abdomen and small pelvis was found filled with infected fluid, particularly after perforation of a gangrenous appendix or gall-bladder, a duodenal or gastric ulcer, the perforation in the latter occurring shortly after a meal, we make a stab intramuscularly in both groins, introduce through it a drain into the small pelvis and the respective lumbar region, and then turn the patient right upon his abdomen, at the same time raising the head end of the bed on the highest blocks (Figs. 124, 125). I feel sure that the convalescence and recovery of some of these patients has been greatly favored by this procedure.

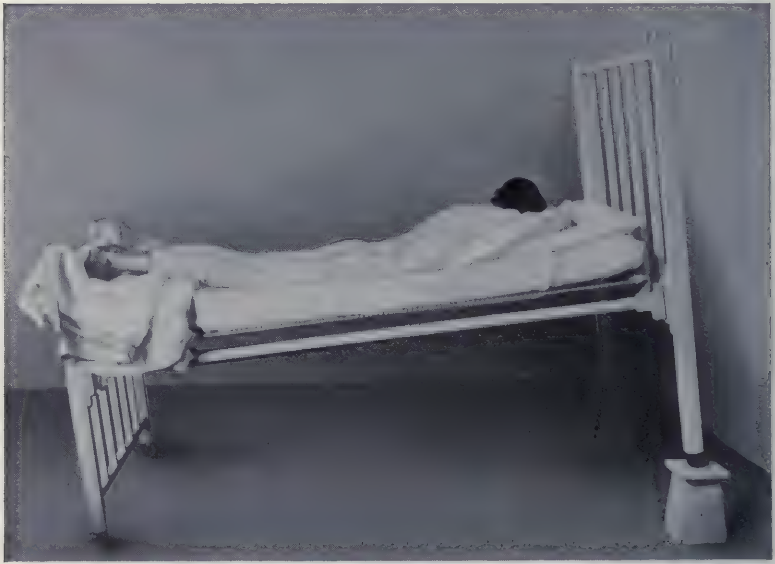

Fig. 124.—Abdominal posture combined with Fowler's (blocks No. 4 under the head of the bed) in cases of intra-abdominal perforation of any sort with large effusion, both lumbar regions and the small pelvis being drained through intramuscular stab wounds on both sides.

In this connection I must still briefly discuss the claim that the right Sims' posture employed immediately after operation, with the patient slowly recovering from the anesthetic, favors the appearance of a postoperative pneumonia, which latter complication is so often seen affecting the right lung. I do not believe in the correctness of such an assumption. During all my experience, particularly in former years, I have kept old patients after suprapubic cystotomy or prostatectomy with drainage of bladder and prevesical space in the Sims' posture, without remembering to have seen pneumonia more readily appear in its wake. It is true the order given in these cases always has been to change the posture from right to left, or vice versa, every six to eight hours. However, it has often happened in the course of the first day that the patient desired to remain on his right side—provided this happened to be the first in which he had been placed—yet no pneumonitis was observed. On the contrary, if combined with early breathing exercises, beginning as soon as

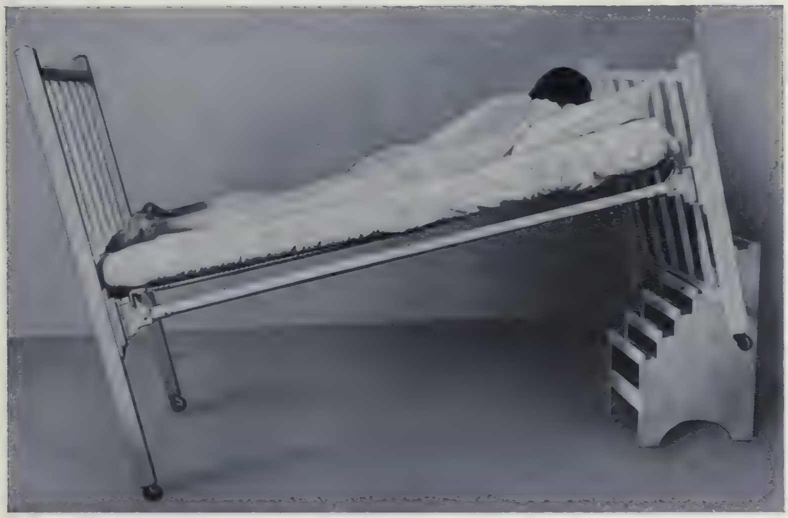

Fig. 125.—The same posture, increased, the upper part of the bed raised on the steps.

the patient comes out of the anesthetic, I think that only benefit will accrue from the arrangement discussed.

As already mentioned, I have gone even a step further in the course of the last three years, commencing the Sims' posture *immediately after operation*, viz., while the patient is still in the operating room. In January, 1918 I did a posterior gastro-enterostomy for duodenal ulcer on a private patient. The anesthetic was given by a specialist who is rightly considered an authority in this line not only in New York and our country, but the world over. On the trip from the operating room down the elevator to the respective floor of the private building, with the patient lying on his back on the stretcher, he vomited the bloody contents of his stomach so suddenly and in such quantity and evidently, unfortunately, coinciding with an inspiration, that even the usual, most careful vigilance of the accompanying anesthetist could not prevent the partial flooding of the trachea and upper bronchial tree. It required quite some continuous careful attendance before free respiration was restored, not to speak of the anxiety endured before we knew definitely that an aspiration pneumonia would not likely set in. Later, discussing this occurrence with the colleague in question, we came to the conclusion that it would certainly be best for the patients' interest if when they were being lifted from the operating table they were placed "*immediately upon the stretcher wagon*" in the Sims' posture, this to be continued in the bed. We felt that then aspiration of the stomach contents, however small in volume, could not occur, because everything regurgitated from the stomach would, on account of gravity, have to flow to and out of the lower angle of the mouth.

The same holds true for stomach lavage, postoperatively, in cases of acute dilatation as well as persistent vomiting, or, ante-operatively, as, for instance, in retroperistalsis due to intestinal obstruction. Here Sims' posture combined with a slight Trendelenburg posture is a most valuable preventive of aspiration into the lung.

To prove the correctness of the above contention, that immediate postoperative Sims' posture arranged on the stretcher at the time of the patient's return from the operation and then continued in bed, does not favor the development of pneumonia, but will rather prevent it, I would mention that I have been told that one of our large city hospitals has adopted this posture immediately after operation as a routine and has since observed a great reduction in the occurrence of the much-dreaded postoperative pneumonitis.

Gentlemen, I would like to continue speaking on this most interesting subject, but my time is up. I have no doubt that many surgeons, here and abroad, have observed these measures to the advantage of their patients, as I have done for a great number of years. What I wanted to bring out is, that methodic insistence on certain postures in postoperative treatment will often enable us to avoid the eventual occurrence of serious complications.

"Prophylaxis, the prevention of disease, is the highest aim of medicine."

CONTRIBUTION BY DR. CHARLES L. GIBSON

Attending Surgeon, New York Hospital

and

DR. KENNETH JOHNSON

Instructor in Surgery, Cornell University Medical College

PNEUMOCOCCUS PERITONITIS

Pneumococcus peritonitis is a very interesting condition and, while not very common, presents very important problems in etiology, diagnosis, and choice of treatment.

The disease is probably more frequent than would be indicated in the literature if we include, as we must, only cases verified by bacteriologic examinations, as probably in many cases no attempt at bacteriologic examination is made, or is done so imperfectly as to be valueless. All authors speak of the difficulty of diagnosis. This view we do not share, as there are certain striking features of this condition which should put us on our guard. The 6 cases here reported on the First Surgical Division of the New York Hospital and a study of the reported cases bring out certain features.

In the typical acute cases we are dealing with young children, mostly girls.

The onset in most cases is typical of an acute peritonitis. The vomiting is irregular and not persistent. The temperature, pulse, and respiration are usually quite elevated. Physical examination shows an obvious and usually generalized abdominal distention, but the tenderness and resistance much less marked than one expects with the combination of these symptoms. The patients, while obviously acutely ill, are in pretty good condition; much more so than is seen in peritonitis from appendicitis at this stage. All show a certain characteristic hebetude;

a few minutes after disturbing the child by palpation it will go to sleep quietly. Some of these cases will show a herpes labialis. A certain duskiness is also described by many authors.

Given the above facts, one should certainly think of pneumococcus peritonitis, especially as appendicitis is not very common in young children. Typhoid fever, the other condition to be thought of, is also rare in small children, and the hyperleukocytosis of pneumococcus peritonitis contrasts with the leukopenia. It is more difficult to eliminate a pneumonia.

At operation the diagnosis should also be possible. We find a large amount of fluid with the relative mildness of the peritoneal irritation, much less than in appendical peritonitis; the color of the fluid pearly or milky white, total absence of colon bacillus smell. Then the signs of peritoneal irritation and agglutination of coils of gut are not localized. The appendix may share in the general irritation of the peritoneum, but one notices no gross structural changes.

Syms (Annals of Surgery, March, 1918[1]) reviews the subject of pneumococcus peritonitis very elaborately. Since that time a certain small experience has developed regarding the types of pneumococcus involved; otherwise, we have no findings to offer which either controvert or add to his conclusions except the question of treatment, in which we differ from his views and the majority of those who have considered this subject.

We quote verbatim the conclusions reached by Syms:

"Idiopathic peritonitis does occur.

"Pneumococcus peritonitis is a rare disease. Netter found it twice in 140 cases of peritonitis bacteriologically examined. In 104 pneumococcus infections in adults he found no case of peritonitis; in 47 such cases in children he found 1 case.

"Pneumococcus peritonitis particularly affects girls. Under fifteen years of age the proportion is 3 girls to 1 boy.

"Pneumococcus peritonitis may occur: First, as a single lesion, *i. e.*, alone; second, as a sequel to some other site of infection, as the lung, pleura, etc.; third, it may be followed by invasion of other localities, lung, pleura, etc.; fourth, it may be a local manifestation of a general septicemia. Probably it is always that.

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[1] This article contains twenty references in the literature.

"Pneumococcus peritonitis is found in two forms: First, the diffuse; second, the encysted. These forms may represent different types or varieties of the disease or they may represent different stages of the disease. This is yet to be demonstrated.

"When the peritonitis is encysted the prognosis is good, spontaneous recovery may take place in one of several ways. Operation results in a high percentage of recoveries (86 per cent.).

"When the peritonitis is diffuse the prognosis is bad—death is the rule. Operation results in very high mortality (86 per cent.; in some series 100 per cent.).

"We recognize a symptom syndrome which should make diagnosis reasonably certain in typical cases.

"Operation should not be performed in the diffuse form.

"Operation should always be performed in the encysted form.

"The above represents the sum total of our present-day knowledge of this subject as set forth in the literature to date.

"While I have nothing new to add to this subject, I feel that I may be performing a service by propounding certain questions which have not yet been answered. The satisfactory solution to some of these questions would go a long way toward improving our treatment of this disease.

CERTAIN POINTS OF INTEREST AND IMPORTANCE WHICH ARE YET TO BE CLEARED

"1. Why is the disease most common among children?

2. Why is the disease more common among girls than among boys?

3. How does the disease invade the peritoneum?

4. Is there a local port of entry?

5. Is there always septicemia?

6. Will the blood always show pneumococcus? If not, in what per cent.?

7. Is the secondary form caused by blood infection?

8. Why is diarrhea so frequently a symptom?

9. Is there commonly an enteritis?

10. Do the diffuse and encysted forms represent types of the disease, or do they represent stages?

11. If they are two different types of the disease, are they caused by different types or strains of pneumococcus?

12. Have pneumococci been classified in this and in other lesions, as they have been classified in pneumonias?

13. What can we hope from serum treatment in this disease?

14. Are the chlorids diminished in pneumococcus peritonitis as they are in pneumonia?

15. Will the administration of chlorids show the same benefit they have shown in the treatment of pneumonia?

"Before closing, I will touch briefly upon some of these questions. The first four are really of academic interest, and will undoubtedly be answered more or less completely as time goes on.

"5, 6, and 7 may be covered by one answer. There is undoubtedly always a bacteremia; the peritonitis is really a local manifestation of a systemic infection. When peritonitis is secondary to some other lesion, as pneumonia for instance, the disease doubtless reaches the peritoneum through the blood-stream. Undoubtedly the blood should always show the presence of pneumococci. I cannot do better than to again quote the words of my friend, Doctor James G. Dwyer, to whom I put this question:

" 'The disease probably gains access to the peritoneum through the blood. It is probably always a bacteremia, the organisms circulating through the blood and localizing in the peritoneum. Blood-cultures if taken often enough, at the proper time and sufficient blood drawn, would be a valuable method of diagnosis on this point. A negative blood finding would have no meaning, as the mechanical and bacteriologic reasons of why we get negative blood-cultures when we should get positive hold good here. Blood-cultures should show a bacteremia.'

"10, 11, and 12 may similarly be expressed in one answer. Thus far the pneumococcus in its relation to peritonitis has not been systematically studied as it has in its relation to pneumonia, though some investigation along this line was made by Michaut many years ago.

"Whether the diffuse peritonitis cases with extreme toxemia represent a distinct type and are caused by a strain of pneumococcus of extreme virulence (Group III) remains to be proved. It is a matter of the greatest importance and should receive the fullest possible investigation. For this purpose, bacteriologically, our peritonitis cases should be subjected to the most intensive study.

"Serum therapy should have the same place here as it has in the treatment of pneumonia.

"The questions as to the chlorids yet remain to be investigated and answered."

Etiology.—The etiology of this condition and the portal of entry of pneumococcus remain an unsolved problem. We can offer no views of our own. One is tempted to think that in some patients the peritonitis is postpneumonic, the original condition having been mild or having pretty well cleared up when the patient comes under observation. Naturally, the frequency in girls suggests the pelvic viscera. Why the disease affects chiefly young children we have no good explanation.

Symptoms.—The duration of symptoms before coming to operation is variable. Usually the onset is not very acute and the progress not very rapid. The symptoms are mostly abdominal, pulmonary being either absent or mild. These are not incompatible with mild pneumonias in children.

Vomiting is generally noted, but not so typically as is usual in progressive peritonitis. Diarrhea is mentioned about as often as constipation. Torpor or hebetude of some degree, the manifestation of an intoxication, is a constant sign and the patient presents a picture of general malaise. Chills are exceptional as they are in the pneumonias of children.

Abdominal pain is a constant manifestation and begins early. It tends to be constant and progressive. It is earliest referred to the lower abdomen rather than the upper. With the progress of the disease it is referred to the whole abdomen. On physical examination we note distention of the abdomen with tenderness to palpation and rigidity of the muscles, but the tenderness and resistance do not seem to be marked as one should expect in relation to the other symptoms, particularly the distention and the elevation of pulse and temperature.

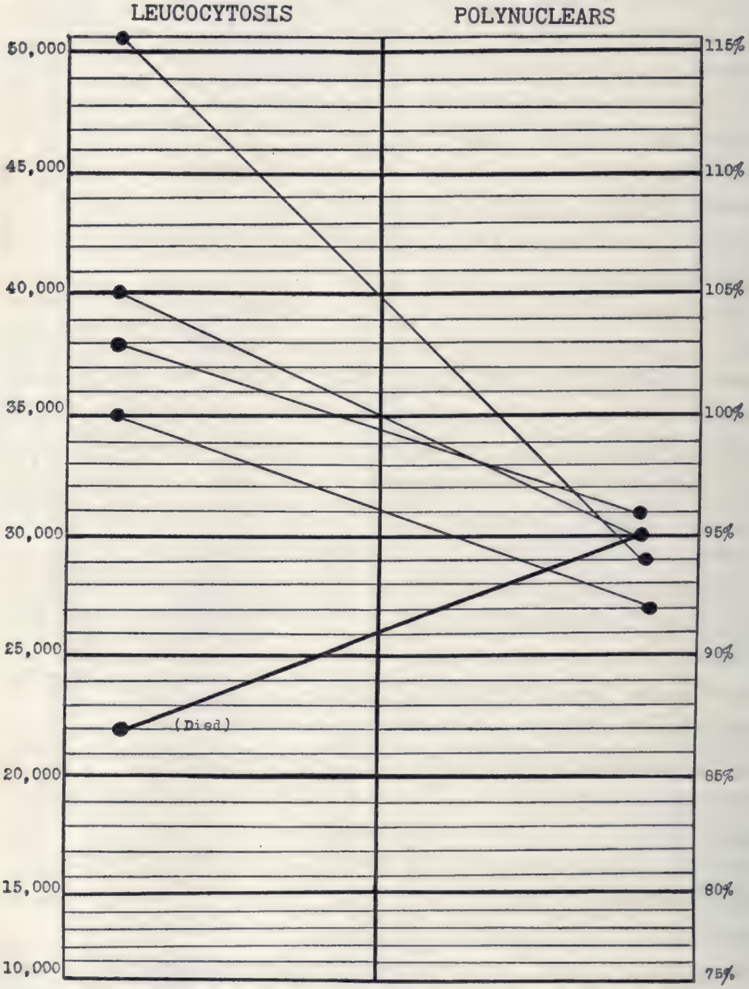

Fig. 126.—Differential count in 5 cases of pneumococcus peritonitis.

Pulse and temperature run high and are typical of an acute peritonitis.

Blood examination (Fig. 126) is a tabulation of the differential counts made before operation in 5 of our cases. They are computed on the Standard Chart described by Gibson in the Annals of Surgery, April, 1906. According to the views then formulated the direction of the line joining the two records —total leukocytosis on one side, percentage of polynuclears on the other—has some bearing on the body resistance to infection.

Spreading infections and infections that meet little resistance should give a rising line; localized or well-borne infections, a line which tends to the horizontal or points downward. The accompanying table shows two interesting features—the unusually high leukocytosis seen in the bulk of these pneumococcus peritonitis cases and the sharply descending line in all but the one fatal case.

Examination of the blood by culture is variable. We have no data regarding the early appearance of the bacteria and only imperfect data as regards its disappearance in the cases remaining under observation. When both the blood-culture and the culture from the peritoneal fluid have given definite results as regards grouping under the four types of pneumococci they have agreed. While in all our cases we have obtained a culture of the peritoneal fluid, we have only data on the blood-cultures in Cases III, IV, V, and VI. Cases IV and V sterile. Cases III and VI showed pneumococcus.

Clinical Types of Pneumococcus Peritonitis.—Most authorities speak of a localized type and a generalized type, and usually conclude that the localized type is the end-result of a generalized type. Some cases in the literature have been reported of operations consisting in the evacuation of a well-defined localized abscess rather than an actual peritonitis. Most authorities recommend giving the generalized type expectant treatment in the belief that operation at this stage is usually futile or attended with very bad results, and it is better to wait for the manifestations of a more localized type. To this view we cannot give our assent.

Treatment.—Shall we operate? If so, when and how? Obviously, the thought occurs that if the pneumococcus peritonitis represents a localization of a general process, there should be a reasonable probability of the condition getting well spontaneously with the subsidence of the general infection. The time has not yet come, we think, when we dare wait on these acute cases, for we think it would be most unwise, with the present limitations of diagnosis, to take the chance of letting a peritonitis from an appendix (or other condition) slip through our hands. Even if we could make a diagnosis from a blood-culture some forty-eight hours would have elapsed. Possibly more rapid methods of certain diagnosis may be developed in the future.

As stated above and for the reasons outlined, we differ from other writers who warn against operating in the diffuse form. The opponents of immediate operation have based their views on the great mortality said to attend early operation (Annand and Bowen give 86 per cent. mortality), but our personal experience has been favorable—16 per cent. mortality.

If an operation is performed in the acute stage a fairly thorough exploration should be made, the appendix always seen, and it would be wise to take it out, as it may possibly be the source of trouble. The preponderance of opinion has been in favor of drainage. The opening in the abdominal wall can be closed for the most part. The only fatal case in our series was not drained. In this case the amount of fluid was quite small and the peritoneal irritation slight.

Specific therapy, certainly in theory, is desirable, and although the case for specific therapy is not quite settled, we think all will agree with us that it is desirable to isolate promptly the particular type of pneumococcus and administer the corresponding serum. The reports of types isolated have been largely of Groups I and II, Group I predominating. The question comes whether we should wait the necessary time for the differentiation or rather begin the administration of the most frequent, Group I; or is it better to begin with the so-called polyvalent serum. The whole subject is very important, and it is hoped that publication of this paper may stimulate the study of the question. We are emphatically against resorting to the specific therapy as against operation, as we still believe that the best judgment calls for operation.

Summary.—Pneumococcus peritonitis is an acute infection occurring in children, and particularly girls.

The relationship of its incidence to a pre-existing pneumonia is not established, but probable in a small proportion of cases.

Patients show the usual signs and symptoms of an acute and extensive peritonitis, but do not seem as sick as usual and the tenderness and rigidity are also less marked. There is a drowsiness or torpor which is constant. Herpes labialis is seen frequently and is believed to be a valuable diagnostic sign.

Operative findings are typical—large amount of free milky fluid, absolutely odorless. There are no focal manifestations. The peritoneal reaction is less marked than customary with so much exudate.

Treatment recommended is operation at any stage, with pneumococcus serum during the convalescence. Type I serum given until the exudate and blood-cultures demonstrate the presence of one of the other strains.

Operation will consist in median laparotomy, with exploration of other focal sources of peritonitis. The fluid should be completely evacuated by suction and a temporary rubber drainage-tube led into the pelvis. Closure of the wound and usual after-treatment, particularly Fowler's position.

It is our belief, supported by our own experience, that the mortality should not be high, contrary to the generally expressed belief of other authors.

Case I.—Lilly L. Age seven. Admitted June 9, 1913. Discharged July 16, 1913.

Chief Complaint.—Pain in lower abdomen.

Present History.—Yesterday vomited several times and had frequent watery stools. At 3 A. M. today had a sudden severe pain in the epigastrium. It was colicky in nature and later became more localized to the right lower quadrant. Vomited several times during the day and had a marked diarrhea. (No mention made of chill in old history.)

Past and Family History.—No bearing on case.

Physical Examination.—Well developed. Acutely ill.

Head: Tongue badly coated. Mucous membrane of mouth dry.

Thorax: Expansion good and equal.

Lungs: Resonance good. Breath sounds clear everywhere.

Heart: Sounds of good force. Regular. No murmurs.

Abdomen: Distended. Tympanitic. Tender everywhere. More marked in right lower quadrant. Some muscle spasm.

Operation.—Appendectomy for acute appendicitis. Appendix slightly congested. A small amount of fluid of a serum nature free in abdominal cavity.

Course.—Operated upon on day of entry. Eight days later as condition was same—temperature high, pain present in abdomen, and no signs of improvement—patient was transferred to medical side. Wound was clean. No redness or distinct tenderness along incision line. Entire abdomen distended and tender. Stools foul and loose. Was diagnosed here as pneumococcus peritonitis. Wound broke down and pus evacuated. Pelvic abscess formed. Was opened June 25th, and a culture showed it to be a pneumococcus peritonitis. It was not felt that the original condition was the same.

Clinical Pathologic Findings.—Laboratory report of appendix: Acute catarrhal appendicitis.

Bacteriologic report: Culture of pelvic abscess—pneumococcus.

Blood count: On entry, W. B. C., 51,500. Polys., 94 per cent.

Four days later W. B. C., 15,000. Polys., 82 per cent.

Respiration: High, 30–36.

Pulse: High, 112–160.

Temperature: Irregular—from 101° to 104° F. Did not come down for over a month.

Case II.—R. S. Age nine. Admitted April 19, 1915. Discharged May 25, 1915.

Chief Complaint.—Three days ago was suddenly taken sick with cramplike pains in epigastrium. A few hours later she vomited three times at intervals and had a severe chill. The pain persisted for next two days and became more severe. It extended over the whole abdomen and was associated with tenderness, especially on the right side. No headache and no cough. Frequent greenish stools.

Past History.—No bearing on case.

Physical Examination.—Well developed and well nourished. Appears drowsy and acutely ill.

Head: Face flushed. Nose normal; alæ nasæ move with respiration. Mouth: marked bilateral herpes labiales. Tongue very furred.

Neck: Tenderness on both sides along line of carotids. Bilateral enlargement of submaxillary nodes.

Chest: Expansion limited and rapid. Respirations 30 to 36.

Lungs: Normal percussion and breath sounds. Patient seems unable to draw a deep breath and breathes with upper part of lungs. Dr. Conner found absolutely no lung condition to warrant diagnosis of pneumonia.

Heart: Second pulmonic accentuated. Pulse about 100.

Abdomen: Walls rigid over the entire abdomen. Marked tenderness over entire abdomen. Does not appear to be localized.

Clinical Pathologic Findings.—Urine: Negative.

$$\left.\begin{array}{r}\text{Blood count: On day of admission, W. B. C., 40,000}\\ \text{Polys., 95 per cent.}\end{array}\right\}\begin{array}{c}\text{300}\\ \text{counted.}\end{array}$$

Nine days after admission, W. B. C., 31,000
Polys., 88.5 per cent.

$$\left.\begin{array}{r}\text{Seventeen days after admission, W. B. C., 24,000}\\ \text{Polys., 86 per cent.}\end{array}\right\}\begin{array}{c}\text{200}\\ \text{counted.}\end{array}$$

Twenty-two days after admission, W. B. C., 11,200
Polys., 81 per cent.

Operation (April 19, 1915).—For acute appendicitis with diffuse peritonitis; 3-inch oblique McBurney incision. Large amount of thin yellow pus found in abdominal cavity. Appendix was swollen, red, and covered with fibrinous exudate. Drain inserted. Discharged for two and a half weeks.

Laboratory Report of Appendix.—Chronic catarrhal appendicitis with acute inflammation of peritoneal surface.

Bacteriologic Report.—Organism isolated from material in abdominal cavity was undoubtedly the pneumococcus.

Five days after admission cough developed. Lasted a week. There were a few scattered râles at the time. Breathing slightly changed. Respiration rapid, 30 to 36. Pulse 140 at first. Gradually came down to about 100 in five weeks. Temperature:

First week, 101.3° F.; operated, ranged from 100° to 103° F.

Second week, 100° to 102° F.

Third week, 103° F.

Fourth week, around 99° to 101° F. Touched normal once.

Fifth week, around 99° F.

Case III.—M. F. Age six. Admitted April 29, 1915. Discharged June 10, 1915.

Chief Complaint.—Pain over lower abdomen.

Present History.—Yesterday was suddenly taken sick with cramplike pains in the abdomen (not localized). Ate a hearty meal, which was retained, and patient felt better; but four or five hours later pain came on again. There was nausea, vomiting, and increase of colicky pain. Could not eat and was kept awake all night by sharp, stabbing, cramplike pains. Headache persistant. Bowels constipated.

Past History.—No bearing on case.

Physical Examination.—Well-developed child. Is acutely ill.

Head: Tongue much coated. Tonsils slightly enlarged. Alæ of nose did not move in respiration. Herpes around lips not marked.

Thorax: Fremitus, percussion, voice and breath sounds normal throughout. No râles. Four days after admission there were a few crepitant râles in right lower lobe posteriorly. No change in breath and voice sounds or on percussion.

Heart: Rapid—130. Otherwise O. K.

Abdomen: Rigidity over entire abdomen, and generalized tenderness. The slightest pressure anywhere caused great discomfort. Especially marked on right lower side.

Clinical Pathologic Findings.—Urine: 1019, alk., amb. Tr. alb., no glucose. Many hyaline and granular casts.

Blood: On admission, W. B. C., 38,000. Polys., 96 per cent.

Four days after admission, W. B. C., 14,000. Polys., 79 per cent.

Nineteen days after admission, W. B. C., 16,600. Polys., 74.5 per cent.

Operation (April 29, 1915).—For acute appendicitis. McBurney incision. Considerable thin, light, non-odorous fluid in peritoneal cavity. Appendix was swollen, red, and covered with fibrinous plaques. Removed. Culture taken. Drain inserted. (Drain removed in eight days.)

Laboratory Report of Appendix.—Acute catarrhal appendicitis with acute peritonitis.

Bacteriologic Report.—Organism isolated showed to be pneumococcus.

Blood Culture Report (April 29th).—Organism isolated from this culture when grown on human blood-agar shows colonies resembling the pneumococci. Inulin fermented in twenty-four hours. Diagnosis: Pneumococcus.

Four days after admission cough developed and lasted for six days. At this time râles in right lower lobe posteriorly. Respiration high, 30 to 45 per minute. Pulse rapid, 110 to 150 per minute.

Temperature.—First week, 105° F.; after operation dropped to 102° F. in twenty-four hours; 102° to 104° F. for week.

Second week, irregular. Normal to 102.5° F.

Third week, irregular. Big variations from normal to 103° F.

Fourth week, around 101° F.

Case IV.—M. C. Age forty-one. Married. Admitted October 17, 1919. Discharged November 19, 1919.

Chief Complaint.—Pain in upper abdomen.

Present History.—Started three days ago with sudden cramp-like pain in upper abdomen. Next day whole abdomen felt sore and pain of jumping character returned that night, and has continued intermittently ever since. Pain and soreness much worse today than previously. Yesterday took castor oil, but bowels moved but little, and today patient was given an enema. Has always been constipated. Nauseated and vomited past two days.

Past History.—Has not felt well since coming to America seven weeks ago. Has had frequent headaches, but no definite stomach trouble.

Examination.—Middle-aged obese woman, acutely ill. Everything negative except abdomen, which was of boardlike rigidity and distended throughout. Marked tenderness in right upper quadrant just above umbilicus. Slight tenderness over remainder of abdomen. No masses.

Clinical Pathologic Findings.—Blood count: October 17, 1919, W. B. C., 35, 900. Polys., 92 per cent. Lymphos., 8 per cent.

November 2d, W. B. C., 21,600. Polys., 85 per cent. Trans., 3 per cent. Lymphos., 8 per cent. L. mino., 4 per cent.

November 4th, W. B. C., 20,000. Polys., 78 per cent. Lymphos., 22 per cent.

Urinalysis (October 19, 1919): Specific gravity 1024. Reaction alkaline. Color red brown. Microscopic oxalite R. B. C. Acetone and diacetic. No albumin or glucose.

Operation (October 17, 1919).—Peritoneum contained a large amount of turbid serum and flakes of fibrin. Bowel enormously distended, especially cecum. Appendix subcecal, atrophic at its base, swollen, very dark, if not necrotic, at the tip, with some fibrin on it. Exploration of rest of abdomen negative except for a large amount of purulent fluid in the pelvis and a very much enlarged uterus, about 6 x 4 inches, and very hard, but no apparent disease of the appendages. Rubber tube and cigarette drain to the pelvis. Partial closure. Note: Diagnosis of appendicitis is probable, but not definitely established.

Laboratory Report of Appendix.—Acute appendix. The peritoneal surface is the seat of an acute exudative inflammation.

Bacteriologic Report.—Culture from peritonitis shows growth of pneumococcus, Group II.

Blood-culture sterile.

Temperature.—On admission 103° F. Pulse 120. Respiration 32. Eight o'clock temperature day following operation 103.8° F. Then dropped until at end of first week temperature was between 100° to 101° F.

Second week varied between normal and 101° F.

Third week varied between normal and 101.6° F.

Fourth week varied between normal and 100° F.

No pulmonary signs at any time.

Case V.—Sarah G. Age five. Admitted March 29, 1920. Discharged July 7, 1920.

Chief Complaint.—Pain in abdomen, fever, vomiting for past week.

Present History.—Began two weeks ago with cold, cough, and running at nose. Fever has been intermittent. Some days temperature has been 104.2° F. Complains of pain across abdomen. Bowels do not move without enemata. Vomited last week. Mother thinks temperature is higher at night than in the morning.

Past History.—No bearing on case.

Physical Examination.—Young child lying quietly in bed, looks acutely ill, cheeks flushed, breathing slightly accelerated. No cyanosis.

Lungs: Percussion note resonant throughout. Breath sounds vesicular. Few sticky râles anteriorly over large tubes on both sides. No areas of consolidation or bronchial breathing. Pulse good quality, although rapid.

Abdomen: Well nourished, of good conformation. Rigidity over entire abdomen. Tenderness especially localized in area below umbilicus. Owing to rigidity no deep palpation was possible. Dr. Roper felt a mass to right of midline in pelvis by rectal examination.

Clinical Findings.—Urinalysis: Negative. Blood counts: April 1, 1920, W. B. C., 7000. Polys., 55 per cent.

April 2, 1920, W. B. C., 12,000. Polys., 45 per cent. Lymphos., 55 per cent., 200 cells counted.

April 3, 1920, W. B. C., 10,500. Polys., 66 per cent. Lymphos., 34 per cent., 200 cells counted.

Wassermann negative.

Operation (March 30, 1920).—Coils of small intestine and omentum were matted together in the pelvis. Wound was enlarged downward, and on attempting to separate the adherent coils of intestines numerous abscess cavities were opened into.

The pus had no odor, was thick and creamy in character, with a slight greenish tinge, and contained large particles of fibrin. Culture was made from the pus and from one of the pieces of fibrin. All the abscess cavities were between the coils of the small intestine and were chiefly confined to the lower half of the abdomen and especially to the pelvis. All these coils were separated and the abscesses thoroughly opened. The appendix was found lying over the pelvic brim, slightly swollen, but apparently involved from without. Appendix removed. Base ligated. Right fallopian tube was markedly swollen in its peripheral half, but no pus could be milked from it. The origin of the abscess could not be definitely determined. Rubber-dam Mikulicz tampon with two pieces of 4-inch iodoform gauze was then placed in the pelvis, completely blocking off the gut from the abscess cavity. (Localized case.)

Laboratory Report of Appendix.—Subacute periappendicitis. On the peritoneal surface there is a considerable quantity of granulation tissue, infiltrated with polynuclear cells. The wall of the appendix itself is uninvolved.

Bacteriologic Report.—Culture from appendix shows a pure growth of Diplococcus pneumoniæ, Type I.

Blood-culture sterile.

Temperature.—On admission 102.8° F. Respiration 40. Pulse 140.

Discharge Note: Culture of pus in peritoneal cavity reported Group I pneumococcus. Blood-cultures taken on four successive days after operation reported sterile. Convalescence prolonged and stormy. Fecal fistula developed on eighth postoperative day with considerable febrile reaction. Temperature curve thereafter very irregular. Discharged on one hundredth postoperative day with wound practically closed. (Ward in quarantine for last two weeks of child's convalescence.)

Case VI.—Fannie G. (sister of Sarah G., Case V). Age four. Admitted October 31, 1920. Died November 1, 1920.

Chief Complaint.—Pain in abdomen.

Present History.—Two days before admission had pain in abdomen, apparently general. Vomited two or three times after the onset of the pain, vomitus consisting of food taken before. Taking of water seemed to cause vomiting. On day before admission continued to have vomiting. On admission patient has localized pain. Greatest point of tenderness directly above and below umbilicus. Temperature day before and day of admission. No chills. Bowels have moved every day. Enema on day before admission gave no relief.

Past History.—No similar attacks previously. During week before onset of present illness patient had cough. No expectorations and no pulmonary symptoms.

Physical Examination.—Looks feverish, but not acutely ill. Very drowsy. Well nourished. Lungs: Negative for signs of pneumonia. Abdomen: No distention. Some rigidity in lower half. Pain on palpation localized around umbilicus. No masses felt. No organs palpated. Herpes on lower lip.

Clinical Pathologic Findings.—Urinalysis negative.

Blood count: October 31, 1920: W. B. C., 22,200. Polys., 95 per cent. Lymphos., 5 per cent.

Operation (October 31, 1921).—Peritoneum seems a little injected and intestines slightly distended. On pushing up omentum about ½ pint of turbid fluid evacuated. This fluid is rather less milky in appearance than found in such cases. Is perfectly odorless. No lesion. Appendix is somewhat irregular in character and deemed best to remove it. No drainage.

Bacteriologic Report.—Culture of pus from peritoneum shows pure growth of pneumococcus Type I (mouse method).

Culture of blood in plain and dextrose broth shows pure growth of pneumococcus, Type I.

Temperature.—On admission 104.8° F. Pulse 140. Respiration 40.

Discharge Note.—Cultures of blood and of pus from abdominal cavity showed pure growth of pneumococcus, Group I. Lungs negative, though history of recent cough was obtained. Continued to be semicomatose and died twenty-four hours after operation.

Received one dose of polyvalent serum.

CLINIC OF DR. EUGENE H. POOL

NEW YORK HOSPITAL

OPERATION FOR THE REMOVAL OF COMPLETE CERVICAL RIB

OPERATION for the removal of a cervical rib often proves difficult and the result unsatisfactory. Two cases of complete cervical rib are presented; in the first there was incomplete removal; in the second the rib was adequately removed by a procedure to which I wish to call attention. But before describing the operation certain features which are of practical importance will be reviewed.

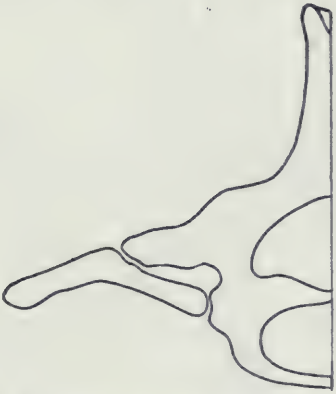

Fig. 127.—Rudimentary cervical rib. (From Ergebnisse.)

Streissler[1] has presented an exhaustive discussion of the subject. The illustrations reproduced from his article give sufficiently in detail the anatomic relationships of both complete and partial cervical ribs (Figs. 127–131).

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[1] Ergebnisse der Chirurgie und Orthopädie, Band v, 1913, 281 (bibliography).

Many people are not inconvenienced in anyway by the presence of such ribs. Others present quite definite symptoms which are dependent upon pressure on the brachial plexus and the axillary vessels, and consist in disturbances of sensation, edema, and local temperature changes. The two cases here presented illustrate quite typically the symptoms which call for operative intervention. Palpation in the supraclavicular region reveals a bony swelling. The presence of the anomalous rib is readily demonstrated by x-ray examination.

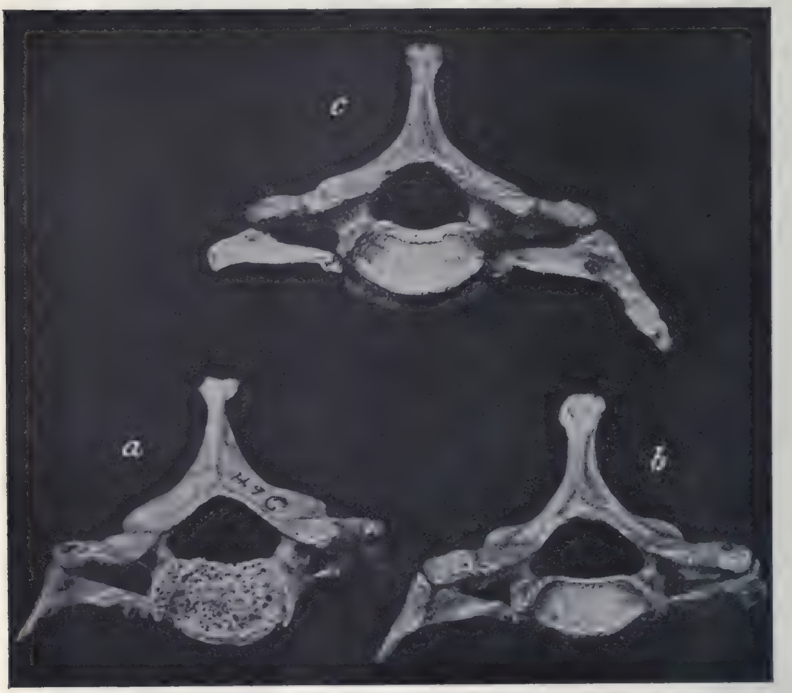

Fig. 128.—Rudimentary cervical ribs. (From Ergebnisse.)

A peculiar feature is that the symptoms frequently begin after some trivial accident, as a fall upon the outstretched hand. Young women are often affected. The patients frequently are the type which suggests hysteria. Yet a real anatomic basis to explain the subjective symptoms, striking objective signs, and the fact that a cervical rib or other anomaly was not suspected by the patient before the onset of symptoms preclude an exclusive psychic basis. Moreover, the symptoms and objective signs usually cease after correction of the anomaly.

Operation is advisable when symptoms develop which are sufficiently severe to incapacitate the patient or to cause persistent suffering or annoyance. To ensure a permanent cure

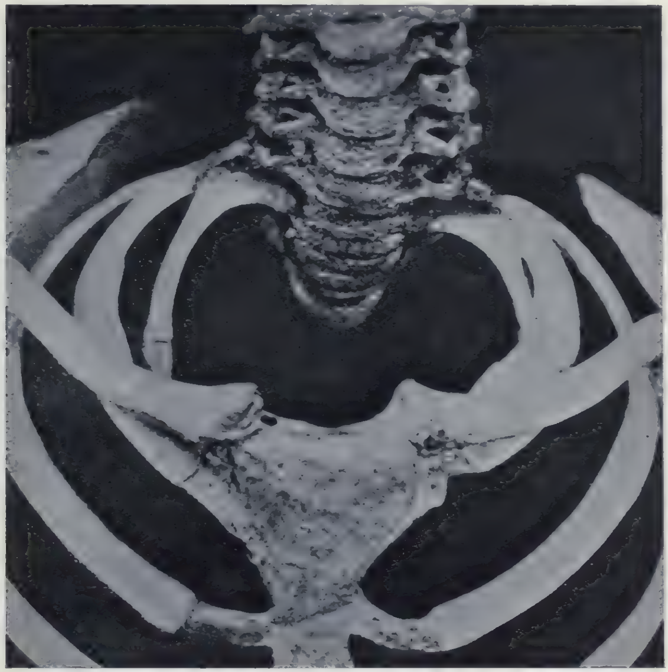

Fig. 129.—Bilateral cervical ribs. (From Ergebnisse.)

Streissler claims that the rib should be removed back to the vertebra and its periosteum should also be removed; otherwise regrowth of bone may occur and cause recurrence of pressure symptoms.

Both anterior and posterior approaches have been recommended. In our first case the anterior method was employed, and the rib was, of necessity, incompletely removed. Although a cure was affected, which may be regarded as permanent, since six years have elapsed since the operation, we have felt that insufficient rib is removed by this method to justify confidence that a cure can be relied upon. In the second case a combination of anterior and posterior methods worked out admirably. The method appears to have features to commend it, especially the fact that the rib is adquately removed. Apparently the chief disadvantage is the possibility of injury to the spinal accessory nerve, but the nerve should be avoided if its situation is borne in mind and the incision through the trapezius is made rather above and behind its course.

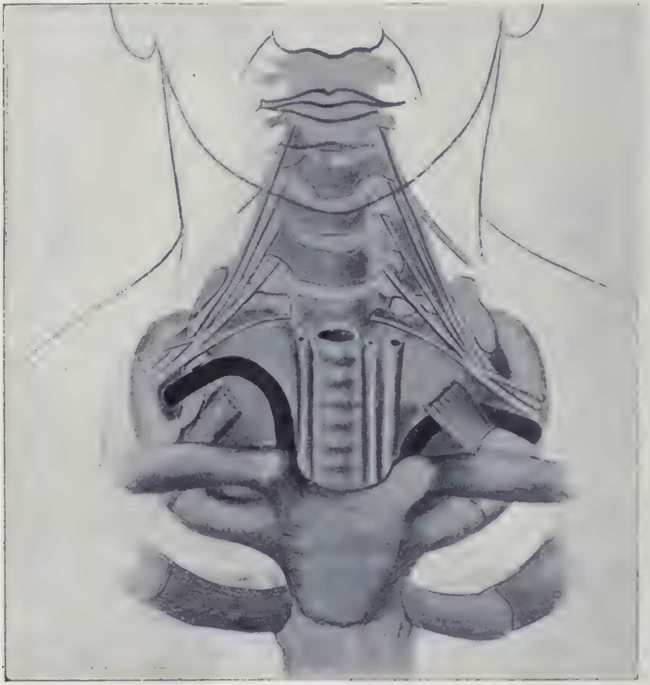

Fig. 130.—Incomplete bilateral cervical ribs. (From Ergebnisse.)

Case I.—L. M., female, age nineteen; operator; single. Admitted to the New York Hospital July 22d; discharged July 31, 1914. Chief complaint was pain and tingling in right hand. Six months before admission patient experienced pain and tingling in right hand. Right arm felt numb. The pain and tingling persisted. Patient said that in August, 1913 she fell on the palm of her right hand; she did not remember any other injury. No member of her family had a similar complaint. The patient was a healthy looking girl. There was slight fulness in right supraclavicular fossa. This fulness was evidently bone. The right hand was slightly colder than the left. Right radial pulse barely perceptible, left easily felt. No difference in sensation or power on the two sides. Knee-jerks present. x-Ray showed bilateral cervical ribs (Figs. 132, 133).

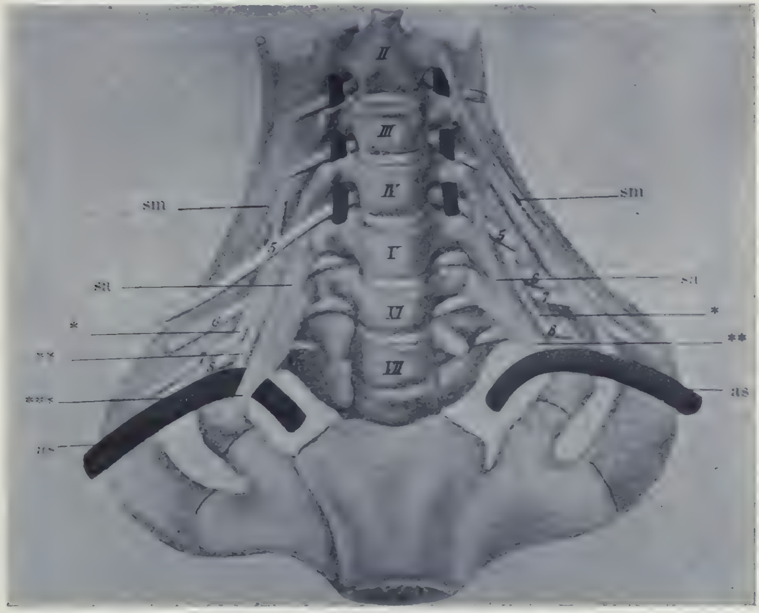

Fig. 131.—Complete bilateral cervical ribs, showing artery and plexus passing over the rib; also attachments of M. scaleni. (From Corning.)

Operation, July 24th: Collar incision 3 inches long; 1 inch above right clavicle. Dissection exposed rib between brachial plexus, which was drawn gently backward, and artery, which was drawn forward with retractors. The anterior portion from beneath plexus to sternum was freed. It was then freed posterior to plexus and rib was cut across as far back as possible. But this was only a short distance posterior to plexus. Its anterior attachment to first rib was divided and the detached portion of the rib, including periosteum, was removed. On discharge wound healed. Pain had almost disappeared.

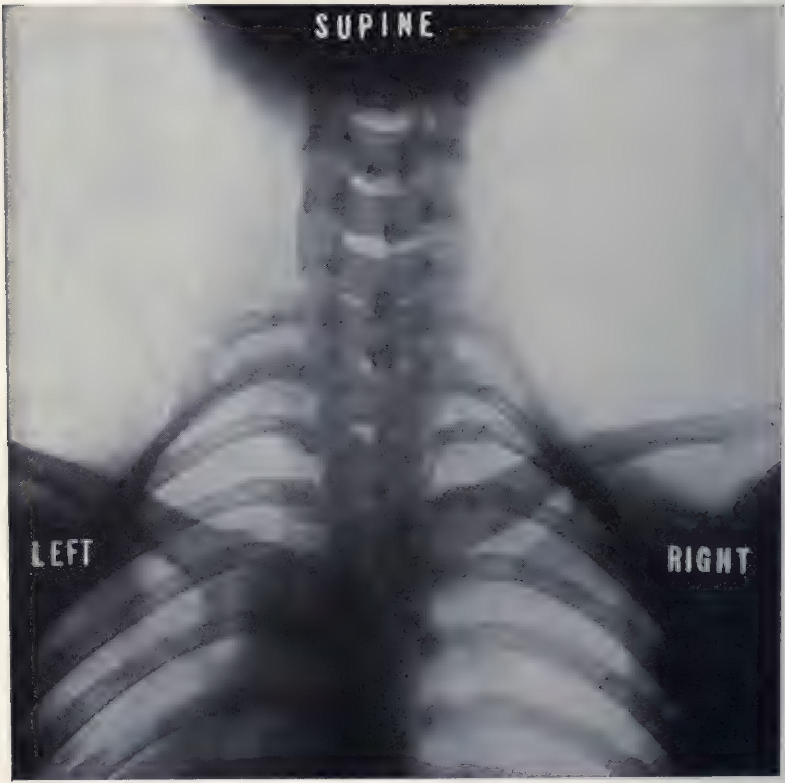

Fig. 132.—Case I. Before operation.

Late result: Patient has experienced nothing abnormal except that her right hand tires more readily than the left; yet she thinks the strength of the two hands is about equal. There has been no numbness or pain. On April 16, 1920 the right pulse is still much weaker than the left. Strength of two hands about the same. Reflexes equal. Apparently slight decrease in superficial sensibility over entire right hand and forearm.

Measurements: *Right*, arm, 29 cm.; forearm, 24.5 cm. *Left*, arm, 30.5 cm.; forearm, 25.5 cm.

Case II.—A. S., female, age seventeen; single; stenographer; admitted to the New York Hospital April 19, 1920; discharged May 1st. Chief complaints were weakness of left arm; transitory swelling of left hand; irregular pains and numbness in left arm.

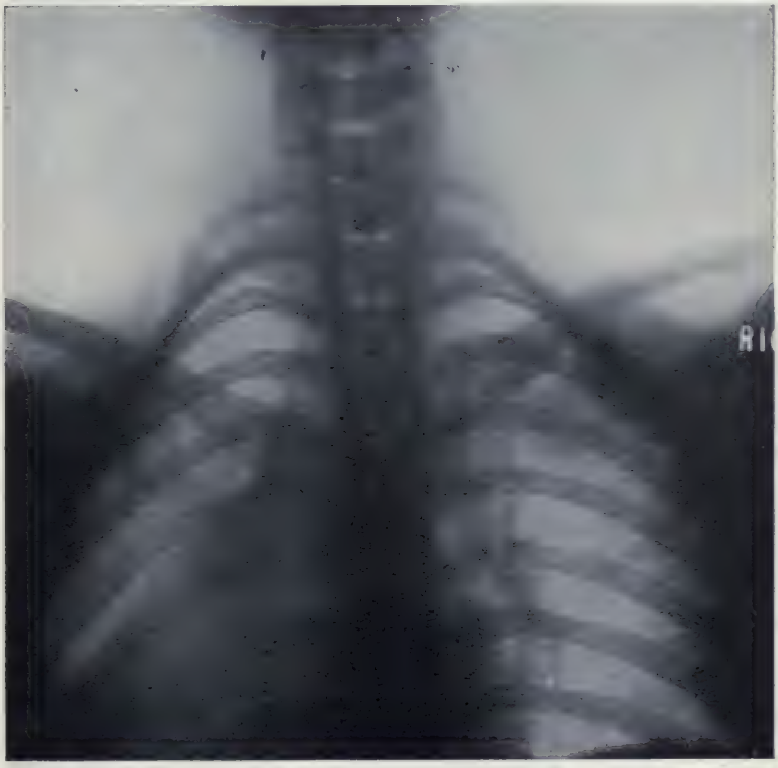

Fig. 133.—Case I. After operation.

Two months before admission patient noticed that while reading she could not hold a book in her left hand as long as in her right. Soon she found that she could not use her left hand

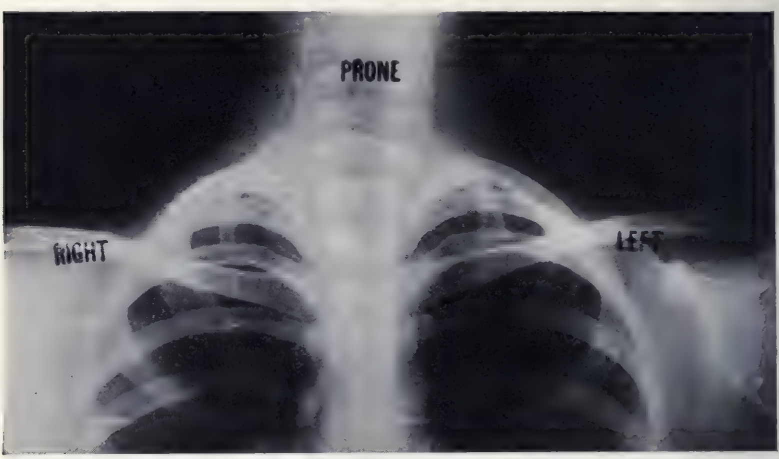

Fig. 134.—Case II. Before operation.

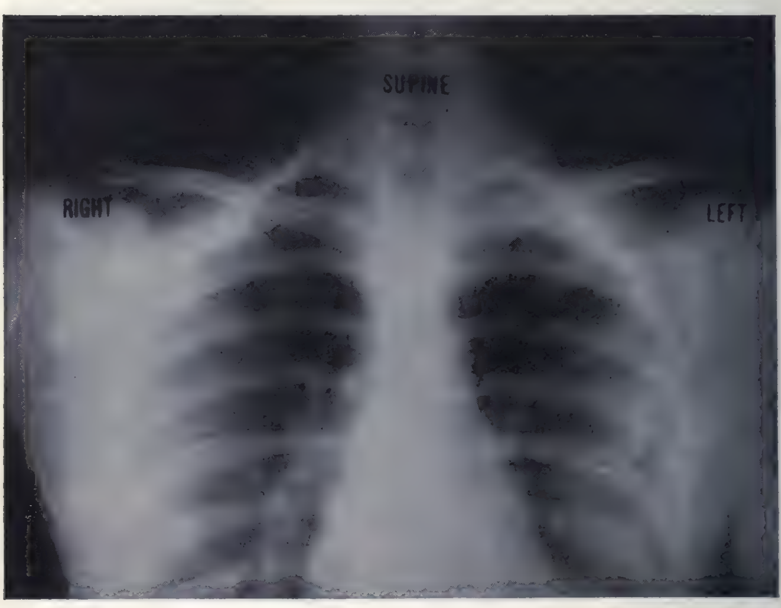

Fig. 135.—Case II. Postoperative.

for typewriting as efficiently as her right. She then noticed that her left hand began to swell occasionally, but only remained swollen for a few hours. She sometimes noticed it in the afternoon, but by the next morning the swelling was gone. Her hand became slightly blue when the swelling was present. About the same time she began to have dull, irregular pains in the left arm. Sometimes these began at the elbow and radiated to the wrist, sometimes they were confined to the axilla, and once pain was felt at the wrist only. Nothing that she did relieved the pain (Figs. 134, 135).

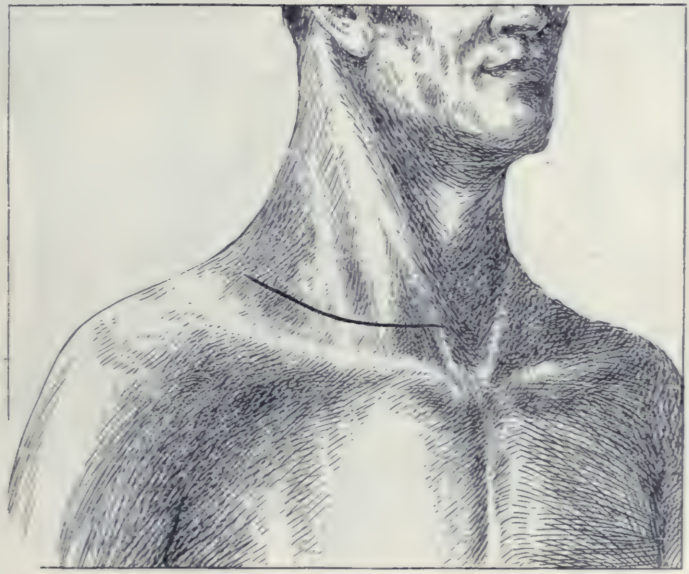

Fig. 136.—Line of incision for removal of cervical rib.

At the same time that she noticed the pain and weakness she noticed that her arm felt numb. This persisted for only a few days. Her left hand at intervals felt colder than the right. Her general health was always excellent.

Previous personal and family history negative.

Physical examination on admission: Well-nourished and well-developed girl. Nothing abnormal was found other than the surgical condition. There was a definite bony resistance in both supraclavicular fossæ. On the left side there was marked tenderness. Both arms equal in size and apparently in strength. The left arm everywhere sensitive to touch and perception of heat and cold. No visible trophic changes in the skin. No points of tenderness. x-Ray showed bilateral cervical ribs.

Operation: Collar incision beginning $\frac{1}{2}$ inch above sternal end of left clavicle (Fig. 136). Platysma and deep fascia cut, external jugular being ligated and divided. Posterior edge of sternomastoid drawn mesially; anterior edge of trapezius incised slightly and retracted for better exposure. Plexus easily defined by blunt dissection. The subclavian artery was readily recognized anterior to the plexus. The plexus was then gently retracted posteriorly and the artery anteriorly (Fig. 137), exposing the rib which

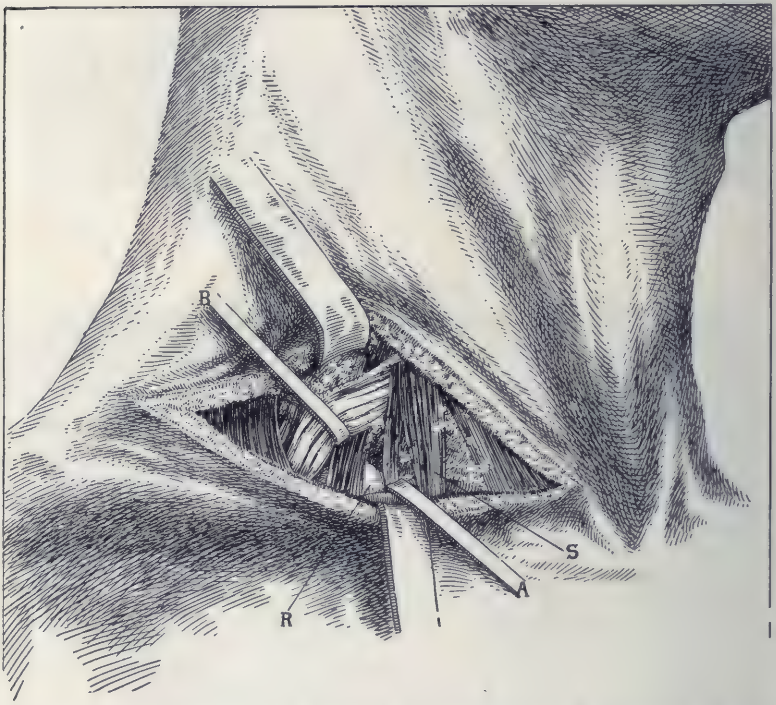

Fig. 137.—Operation for removal of cervical rib: *R*, Cervical rib; *A*, retractor drawing axillary artery forward; *B*, retractor drawing plexus up and backward; *S*, scalenus anticus.

was freed from muscular attachments without entering its periosteum; the intercostal muscles below and the attachments of scalenus anticus and medius being freed. The dissection was carried backward beneath the plexus and forward to anterior attachment of rib. The rib was then freed posterior to the plexus as far back as possible.

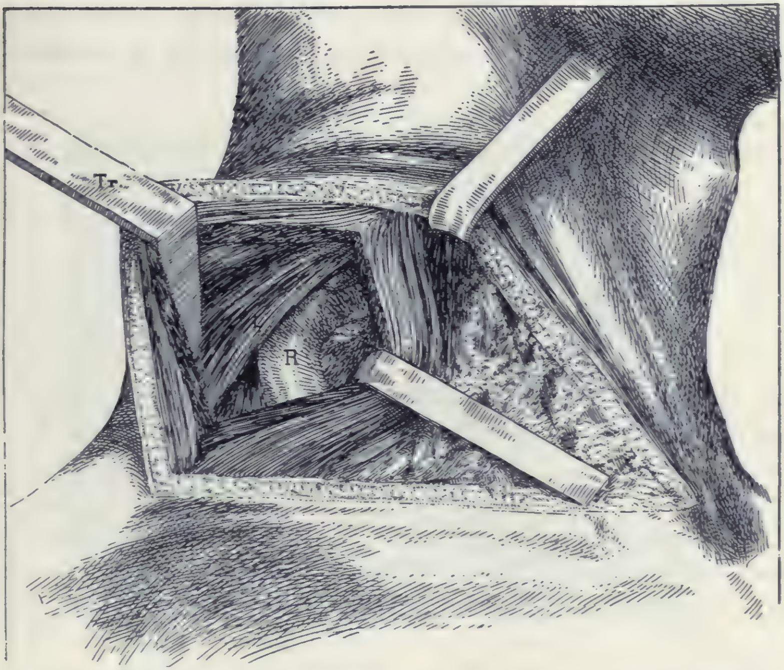

Fig. 138.—Operation for removal of cervical rib. Posterior part of incision retracted upward: *R*, Cervical rib to transverse process; *Tr*, retractor on cut surface of trapezius and (*L*) levator anguli scapulæ.

The parts were allowed to fall together anteriorly and the skin and fascia were freed at the posterior part of the wound and retracted well upward. A vertical incision was made through the muscles, namely, trapezius and levator anguli scapulæ, so that the angle and adjacent parts of the rib were freely exposed (Fig. 138). With bone forceps the rib was cut across without difficulty, including the tip of transverse process of vertebra, leaving the head. Through the anterior portion of the wound the anterior attachment of the rib at sternum was then cut, also with bone forceps. In neither case could a Gigli saw be used on account of the depth, and the fact that anteriorly the rib was so overhung by sternomastoid and subclavian artery that the Gigli saw could not be used safely. Having cut both ends, the rib was readily drawn out through the posterior incision (Fig. 139). Care must be taken throughout the operation to avoid opening the pleura, and gentleness in retraction to avoid injury to the brachial plexus. There is little danger, however, of these complications if the dissection is carefully made.

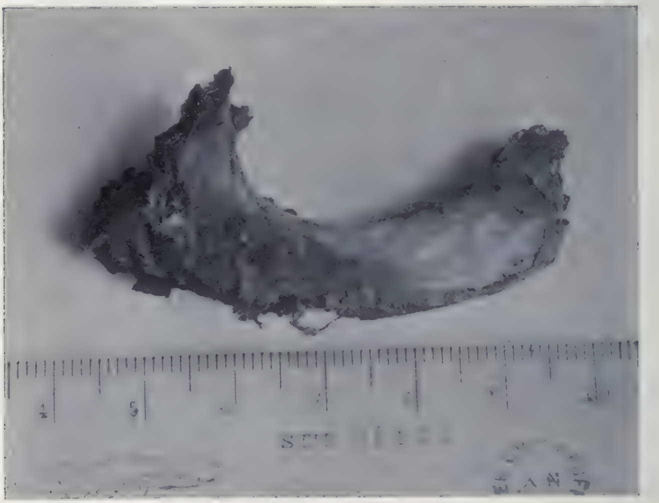

Fig. 139.—Case II. Cervical rib after removal.

Convalescence was uneventful. Wound healed *per primam.*

Late result, September 5, 1920: Patient feels well. No weakness in left arm. No swelling. General condition good. Three weeks after leaving hospital she returned to work. Scar well healed. No nervous symptoms. No limitation of motion;

no tingling or numbness of arm. This method affords easy access to the anterior portion of the rib and allows adequate removal of its posterior part.

Through the courtesy of Dr. Alfred S. Taylor (personal communication) I present the method which he employs, as it appears to have been satisfactory, especially for the removal of incomplete cervical ribs.

Taylor's incision begins over the insertion of sternomastoid muscle. It is carried upward and outward to the edge of trapezius muscle, bisecting the angle between the sternomastoid muscle and clavicle. The incision, according to Taylor, lies in the line of cleavage of the tissues, and therefore leaves little scar. The fat pad which lies in front of the plexus may be divided or displaced upward by blunt dissection. When the plexus is exposed the deep cervical fascia is divided along the outer edge of the upper roots so that the plexus may be lifted slightly forward and slightly inward, exposing the posterior and inner portion of the cervical rib. When the rib extends far forward the anterior portion can be approached through the anterior part of the incision. For a complete rib he advises dividing the rib somewhat behind the brachial plexus and removing the two portions separately. He leaves the head proper *in situ* to avoid damage to overlying vertebral vessels.

Taylor states that the great majority of his cases have been somewhat rudimentary ribs with a prolongation forward to the first true rib by means of aponeurotic bands. These bands, he states, often are as much the cause of symptoms as the rudimentary rib itself; they should, therefore, be resected. For these rudimentary cases the posterior portion of his incision answers for the entire resection.

Conclusions.—Operation is advisable when symptoms develop sufficiently severe to incapacitate the patient or to cause persistent suffering or annoyance.

To ensure a permanent cure the rib with its periosteum should be removed to the transverse process of the vertebra, otherwise regrowth of bone is likely to occur and cause recurrence of pressure symptoms.

By a combination of anterior and posterior methods of approach through a single skin incision, as in Case II, a complete rib may be adequately removed and permanent cure ensured.

CLINIC OF DR. JOHN A. HARTWELL

BELLEVUE HOSPITAL, SECOND DIVISION, CORNELL UNIVERSITY MEDICAL COLLEGE

SUTURE OF MUSCULOSPIRAL NERVE FORTY-SIX DAYS AFTER ITS SECTION BY STAB WOUND

THE first patient is a male, aged twenty-eight years, who was admitted to the service immediately after having received a stab wound in the left arm. Examination showed that a sharp instrument (presumably some type of knife) had entered the arm immediately above the extensor prominence, and had passed through the cubital fossa and emerged on the inner side just above the internal condyle. Some of the extensor muscles had been cut. An examination for injury of the musculospiral nerve failed to disclose this injury. There was disability at the wrist and to the fingers, so far as their extensor action was concerned. This was interpreted as being due to the damage to the muscles themselves. The sensation in the distribution of this nerve is recorded as having been tested, but it was not noted to be deficient.

The stab wound was treated in the usual way by thorough cleaning and suture. Primary union resulted. The patient left the service at his own request on the ninth day. He returned to the follow-up clinic a month later, at which time he showed the typical symptoms of section of the musculospiral nerve at the immediate site of the stab wound (Fig. 140). The muscles on the extensor side of the forearm and the abductors of the thumb showed some atrophy. There was a complete wrist-drop and a loss of power to extend the fingers. Sensory tests showed that there was a very limited loss of pain and tactile sense over the posterior portion of the thumb and of the web between it and the index-finger.

An interesting consideration in this case is the fact that the injury to the musculospiral nerve was originally overlooked. As stated, this was due to the misinterpretation of the muscular disability at the wrist, assuming that it was caused by the damage to the muscles themselves; and, second, as shown this morning, to the very slight sensory disturbance which not infrequently results from the division of this nerve, since there is such an overlapping of the median and ulnar nerves. This impresses upon us the necessity of making a rigid neurologic examination of such cases at the time of their injury.

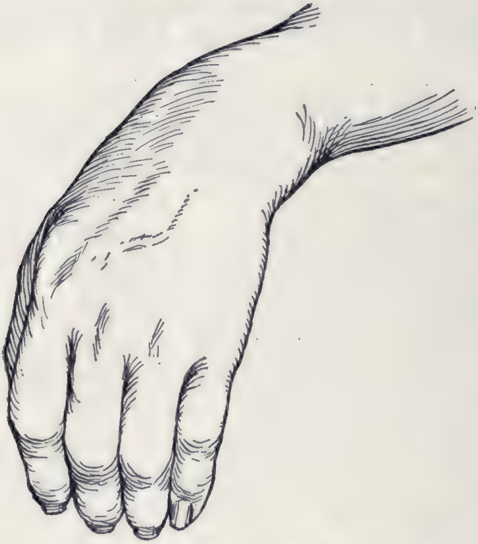

Fig. 140.—Showing complete wrist-drop due to severance of musculospiral nerve prior to operation.

The interval since the injury is now forty-six days. The procedure here will be to make an incision along the normal course of the nerve, as presumably we will find the divided ends with their bulbous formation in the scar tissue caused by the stab wound and the original repair, but in the normal line of the nerve. I shall first look for the nerve above the point of section. The easiest place to find this is where it emerges from behind the humerus and passes into the muscles above the external condyle. On separating the muscles the nerve is seen in this position. The dissection, now carried down, brings us to its entrance into the dense scar tissue, and on dissecting this out we now have the free bulbous end at the point of division. On dissecting through the scar tissue we come here in contact with the distal bulb, and, dissecting it out, we find that it lies about an inch above the division of the nerve into its two main branches.

The problem now is to remove the bulbous ends of the nerve until we come to normal nerve tissue. This is best done by serial section, and the presence of normal tissue is determined by two observations: first, the fascicular appearance of the nerve, showing the different nerve elements of which it is composed lying in parallel bundles; and the second is well termed "blood sweating," which means, as we see here, the oozing of the minute drops of blood from the cut end. The loss of nerve tissue in this case will be very small, so that there will be no difficulty in bringing the two ends into contact by simply flexing the elbow and extending the wrist.

It is now important to bring the two segments of the nerve into their normal rotation relation, that is, so far as possible, the fasciculi of the proximal end must be placed in contact with the corresponding fasciculi of the distal segment. You will have noted that I placed an identifying suture in the perineurium of each segment before dissecting it out. In suturing the nerve care will be taken that these identifications lie in their normal positions; in other words, that there has been no abnormal rotation of either segment.

The nerve is now repaired by the use of this very fine silk, by interrupted sutures passing through only the neural sheath; and so accurately placed that all the fasciculi shall be within this sheath, and therefore in their regeneration will grow immediately in contact with the distal segment. The suture line seems very satisfactory in this respect.

We will now dissect free all the scar tissue, giving a good muscular bed for the nerve. Experience has shown that this is probably the least irritating of any tissue that can be used. As you will note, there is no tension in the line of suture with the forearm and hand in their present positions. It is also seen that the forearm may be moved through an arc of 25 degrees before it throws any tension on the nerve. We will, therefore, close the wound and apply a molded splint to hold the limb in this position.

The subsequent treatment will be to leave the arm in this position for two weeks, at which time the splint will be removed and passive motion made through the 25 degrees that we have just demonstrated can be employed without throwing tension on the nerve. This will be continued for three weeks longer. Experiments have proved that at the end of five weeks the union of the nerve has the same tensile strength as the normal nerve. Accordingly at this time the splint will be removed and the patient instructed to gradually bring the elbow to full extension. The hand, however, will be retained in full dorsal flexion until the muscle power begins to return. Measurement shows that

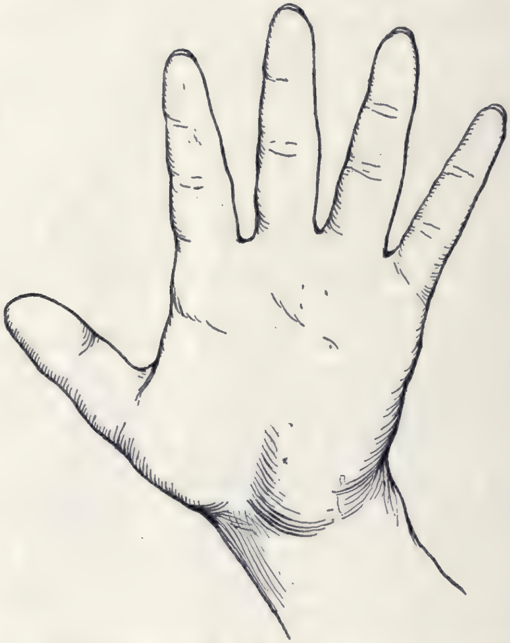

Fig. 141.—Present range of extension of wrist and fingers.

the site of the section is from 90 to 125 mm. above the termination of the nerve into the various muscles that it supplies. We may therefore anticipate that a return of power will occur in from ninety to one hundred and twenty-five days, since regeneration takes place at the rate of 1 mm. per day.

Subsequent Note.—The plan as given above was followed out. Primary union took place. The elbow gradually regained its full arc of motion within two months. The hand splint was retained for a little less than three months, and the first evidence of a return of power actually occurred on the ninetieth day, according to the patient's own statement and our observation. At the end of six months the limb was entirely normal (Fig. 141), there being a complete return of muscular power and delicacy of movement to the forearm and hand; but there still remains a loss of sensation over the terminal distribution of the nerve around the thumb. This condition will last until regeneration has taken place throughout the entire length of the sensory elements of the nerve.

CHRONIC OSTEOMYELITIS

The second patient presents an entirely different problem from the ones previously discussed. He is suffering from a chronic osteomyelitis, and gives the following history:

He is a man aged twenty-eight, who, two years previous to coming under our observation, suffered from what is said to be an attack of "acute inflammatory rheumatism of the back." Exactly what this may mean it is difficult to say, but the important fact is that one week after this illness he received an injury in the right scapular region by being caught in one of the automatically moved heavy doors of a subway train, receiving a rather severe blow at about the middle of the scapular spine. He suffered no immediate serious effect from this, but about six months later there appeared a swelling in the subdeltoid region which was painful and showed the evidence of a mild inflammation with suppuration. This was operated upon and the origin of the trouble was found to be a necrosis of the scapular spine about 1 inch from the acromion. The wound healed up rather slowly, and he remained well until about two months before coming under our care. At this time there appeared a fluctuant swelling just above the clavicle and he showed some evidence of constitutional poisoning. An incision was made in it and the resulting sinus has refused to heal; and from time to time small pieces of necrotic bone have been discharged from it. Examination at the present time shows this discharging sinus, and a probe passed into it travels deeply under the muscles and strikes against bare bone on the ventral surface of the scapula.

The *x*-ray shows what apparently is a fracture at the middle of the scapular spine, but may readily be osteomyelitis; and immediately below the spine there is a clear round shadow which the radiologist has interpreted—without knowing the history

—as a bullet wound through the scapula; with the history, we interpret it as probably a focus of complete necrosis.

The problem in this case, as in all similar cases of chronic osteomyelitis, is purely a mechanical one. We may with absolute confidence promise this patient a cure provided we are able to remove all the dead and infected bone and leave the tissues in such condition that muscular or other soft structures will readily fall in place to fill up the resultant bony defect. In the case of the scapula, as here presented, this should not be a difficult undertaking. You will readily see, however, that if we were dealing with a long hollow bone it might be anatomically a matter of great difficulty to find the necessary soft tissues which would readily fall into the defect. As you see, the probe strikes the scapula, as had previously been demonstrated, and at this point, about half-way to the scapula, is felt a small spicule of bone. With the curet I think we can dislodge this and bring it out through the sinus without enlarging it to any extent. It is now free and is here presented, and, as you see, is a piece of completely necrotic bone which has been working its way toward the mouth of the sinus and has traversed practically half the distance from the scapula to the front of the neck. Undoubtedly it is this small piece that has directly kept the sinus open; but from the fact that we now feel bare bone and the fact that the *x*-ray shows disease of the scapula, a permanent cure cannot be expected unless we remove all disease.

It will not be necessary to cut through the tissues transversely, as we know that it is only the scapula that we desire to attack. We will therefore make the incision over the spine of the scapula at the site of its disease—and here immediately below the spine is found the button of dead bone which the *x*-ray showed, and which on the dorsal surface is directly opposite the point that the probe strikes on the ventral surface. It will therefore be necessary to remove the entire thickness of the bone. This can be done with a chisel, and valuable information will be obtained in this step. As you note, the bone separates rather easily at a definite margin, which indicates that this is the line between the dead and living bone; and contiguous to it we find the granulation tissue in the sinus at its deep end. Examination of the spine itself and of the upper border of the scapula shows that this also is partially denuded of periosteum, and the medullary substance in this direction appears to be infected. This is sufficient evidence that the osteomyelitis is invading this portion to justify its removal, particularly as it will not cause material disability to do so. Removal also will be done with the chisel, and, as you will note, there is again a distinct line at which the bone in its diseased portion easily separates from the normal. With the rongeur we will now remove all jagged pieces and also accomplish the mechanical necessity of leaving a bony defect into which the muscles that have been lifted from the spine will easily fall to obliterate it as soon as it is free from infection.

It is this type of case in which the Carrel-Dakin technic can be used with the greatest ease. We will therefore place the Carrel tubes accurately in all parts of this wound in this way, cover them with the Dakin-soaked gauze, and immediately begin the instillation of the Dakin solution at intervals of one or two hours; and this will be continued until the wound is surgically sterile.

The question now arises as to whether anything will be accomplished by suturing a portion of this wound in order to get early primary union. I am inclined to think that will fail, as this man is rather susceptible to the staphylococcus infection, and it is quite likely that the stitch tracts will become infected. If we have been successful in removing all the dead and diseased bone and the infecting organism is, as we assume, a Staphylococcus aureus, we may hope to accomplish such sterilization in a period of two to three weeks, and, failing that, a cure may be anticipated in the length of time necessary for a wound of this size to heal, which will probably be another four weeks.

Subsequent Note.—The culture taken from the small fragment of the bone at the central portion of the lesion developed pure Staphylococcus aureus. The wound followed the anticipated course. There was a rather severe staphylococcus infection of the suture tracks which necessitated the removal of the sutures on the third day, throwing the wound wide open. This demonstrated that it would have been fully as well not to have sutured the wound at all, as discussed at the time of the operation. No evidence of uncovered bone could be determined after the fourteenth day.

This case is a practically typical example of a patient who has a low resistance to Staphylococcus aureus. His attack of "acute inflammatory rheumatism of the back" was undoubtedly the beginning of his infection in the scapula. It is possible that he might have thrown this off had he not received the subsequent injury, but the two combined were more than he could overcome, and the classical subacute osteomyelitis resulted. The case illustrates in every respect the principles involved in the pathogenesis and treatment of this common affection. It is curable in most instances if these principles are thoroughly understood and our therapy is carried out along the proper line.

ACUTE EMPYEMA

Our third case is one of acute empyema, a subject of unusual interest at the present time. It differs, however, from the usual postpneumonic empyema, in that there is also present a pneumothorax.

The patient is a man forty-two years of age, who was admitted to the medical side on December 20, 1920, with a typical lobar pneumonia of both lobes of the left lung. The sputum showed Type II pneumococcus. The patient ran a very severe course of pneumonia and did not properly defervesce. On the tenth day he developed signs of fluid in the left chest; and on the eleventh day an aspirating needle showed the presence of thick pus and air in the left pleural cavity. He was transferred to the surgical service, and the *x*-ray and physical signs at that time showed that there was an almost complete obliteration of the left thoracic cavity by a pyopneumothorax. The heart was pushed far over to the right and the lung was compressed almost completely around its root. The patient's general appearance, his previous history, and the development of a pneumothorax as well as a pyothorax, strongly indicated that the patient might be suffering from tuberculosis, as a pneumothorax following a definite pneumonia is uncommon.

Repeated examination of the sputum, however, failed to show tubercle bacilli. This negative finding did not convince us that tuberculosis could be excluded, and accordingly we were unwilling to convert the condition into an open draining chest cavity, because where tuberculosis is present this inevitably leads to a chronic suppurating tuberculous empyema which it is almost impossible to cure. Therefore, after thoroughly studying him, it was decided to empty if possible the chest cavity by means of suction drainage. This was done fourteen days ago by the method we regularly use in this clinic. It is simple and effective. Under local anesthesia, at the selected site (in this case the eighth interspace of the scapular line), an incision is carried down to the pleura, in which a small nick is made, and through this is passed a firm moderately large fenestrated tube into the pus-containing thorax. The end of this tube is kept controlled with a clamp. It is fastened at the proper depth with a suture placed in the skin. The wound is very firmly packed with well-vaselined gauze and a copious dressing is tightly strapped around it. This simple device makes an air-tight joint which will remain air-tight usually from one to two weeks. The open end of the tube is then connected with a water bottle, one glass tube of which passes under the surface of the water, and the second acts as a pressure equalizer. The pus will drain from the chest into the water bottle, but on inspiration the water rises in the tube and acts as a valve to prevent the entrance of air. In this particular patient this arrangement remained air-tight for about ten days, during which time he drained a continuously decreasing amount of pus—there being 21 ounces on the first day and 2 ounces on the ninth day. His temperature during this period changed from its previous daily excursion of 98° to 102° F. to a maximum rise of 100° F. During the ten days he maintained a good negative pressure, as determined by the rise of water in the water-valve tube. The physical signs and the *x*-rays show that there has been an expansion of the lung and a change of the heart position toward the normal, so that the remaining cavity in the chest is now not more than an estimated one-fourth of its original size.

The problem that presents itself today is whether we shall consider the patient as on the road to complete recovery without further operative procedure. We believe that experience has amply demonstrated that such is not the case. One of the most potent causes of chronic empyema is inadequate drainage. This patient has been complicated by a frank pleural fistula, as shown by the presence of his pneumothorax. We have no certainty that it is as yet completely healed, although the expansion of his lung is a strong indication that it has. However, the small drainage opening that he has from the first operation cannot be considered adequate to get rid of the remaining pus, with a complete expansion of the lung.

We will therefore proceed to resect a sufficient amount of rib to assure the constant emptying of this cavity. This is done by the classic procedure, except that we will remove the periosteum because it is found in many cases that a regeneration of bone may interfere with the drainage for a sufficiently long period, and in any case it is a complicating factor in maintaining a wide opening. On palpating the chest cavity through the opening we find that the lung can now easily be reached, but there still remains a large anterolateral cavity extending from the diaphragm to the apex of the lung and lying to the left of the heart. We will place one large double drainage-tube and await further *x*-ray study on the progress of the case to determine subsequent treatment.

In general, however, it will be to keep this cavity thoroughly drained, and to prescribe calesthenics and pulmonary gymnastics in order that expansion of the lung may take place as rapidly as the cavity becomes clean.

You will naturally be interested in the question of the use of Dakin's solution in this case. You will recall that the patient had originally a pneumothorax which, as stated, means a bronchopleural fistula. Therefore it would be inadvisable to put Dakin's solution in this cavity except under precautions which will not flood the lung with the solution in case the fistula is still patent. Our procedure will be to permit drainage to take place for a period of five or six days, and then cautiously introduce a small amount of Dakin's solution. If the bronchial fistula is still patent, it will be immediately indicated by the passing of the chlorin gas into the patient's larynx, with the resultant violent coughing. This finding will absolutely contraindicate the use of the Dakin solution. If, however, no such symptom arises, we may conclude that the fistula is closed, of which we already have evidence by the expansion of the lung since the first operation, and we may then proceed to use the Dakin solution in the accepted way. In this clinic we are thoroughly convinced that the proper use of this solution, carefully safeguarded, is a very great aid toward producing sterility of the cavity, and that when sterility is produced we may confidently expect (if no other complications be present) that the lung will expand to entirely fill the chest cavity and that a complete cure will result. You will recall that I am now discussing *acute* empyema, and bear in mind that the problems presented by chronic empyema are quite different.

Subsequent Note.—The procedure above indicated was followed out. The use of the Dakin solution indicated that the bronchopleural fistula had closed. The capacity of the cavity ten days following the second operation was still 300 c.c., but the bacterial count of the discharging pus dropped from infinity on the eleventh day to 4 on the thirteenth day and to 2 on the fifteenth day—the time that this note was made. The patient's general condition is excellent, and we have every reason to hope that his progress will continue as above outlined.

CANCER OF THE RECTUM

The patients to be operated upon this morning are all suffering from gastro-intestinal disease. The problems are quite different from the cases operated upon last week.

The first patient for operation this morning is a man seventy-two years of age, suffering from cancer of the rectum. It is important to note that the history of this condition extends over a period of less than six months, though undoubtedly the lesion has been growing for a much longer period. The first symptom he noted at that time was the development of a diarrhea with from three to eight stools a day, in some of which he noted blood. With this condition he suffered from tenesmus, which was rather constant. He has lost 20 pounds in weight since the summer.

It is important to emphasize that this history is rather typical of carcinoma of the rectum, though in many cases the growth will advance much further than we believe it has done in this instance, with even less marked symptoms. The importance of this lies in the fact that approximately 50 per cent. of the patients presenting themselves for operation in this condition are so far advanced in the disease that radical operation is impossible.

The diagnosis in this case is easily confirmed by a digital examination of the rectum; 4 inches above the anus there is felt an ulcerating mass with crater-like characteristics, which bleeds easily upon examination, but does not obstruct the bowel. It will be noted that no *x*-ray has been taken. The reason for this is that the diagnosis is certain without it, and in this clinic we have a strong feeling that the use of bismuth or other opaque substances in the intestinal tract, where there is marked interference with the proper propulsion of the fecal content along the intestinal canal, should be avoided. We have had experiences in which the bismuth mass has piled itself up behind a partial obstruction and thus has been a serious handicap at the time of operation.

The problems confronting us in cancer of the rectum at this site are two: (1) Is the patient suffering from distal metastasis that makes cure impossible? (2) Is the local condition such that the growth cannot be removed without too great danger to life or of destruction of necessary organs, for example, the bladder and ureters?

It is our belief that these questions can be answered only by an inspection within the abdomen, and therefore in all cases our first step is to open the abdominal cavity. It is the rule to find the earliest metastases in the liver, so that this organ is first examined. The local growth is then palpated and a decision reached as to its operability.

We believe that any cancer of the rectum which can be reached by the examining finger cannot be cured except by a removal of the entire lower segment of the rectum, including the anal sphincter. A study made by the operator some years ago, and published in the Annals of Surgery, showed that an attempt to remove these growths with preservation of the sphincter resulted in a very large percentage of local recurrences or severe stricture. You will please bear in mind that I am referring to cancers situated at or below the peritoneal reflection. Those situated higher, about or above the rectosigmoid junction, present a different problem with a different solution.

We will now open the abdomen in its lower part by the incision that we have found most satisfactory, namely, through the middle of the left rectus sheath, from the umbilicus downward to the pubis. The rectus muscle is then drawn out from the midline, thus preserving intact its blood and nerve supply, and the posterior sheath is opened a short distance from the midline. On repairing this abdominal incision all the structures may be placed in their normal relations, and it has been our experience that hernias do not occur. Incidentally it may be remarked that this same incision is used in the upper abdomen for our gastric and gall-bladder surgery for the most part.

Exploration.—We will now explore the liver, which, you see, can easily be done by passing the entire hand through this incision. The liver is normal in size and consistency, and is reached easily in all its parts. Metastases, when present, show themselves by small or larger nodules situated beneath the peritoneum and are easily recognized. The total absence of this condition is sufficient evidence that the liver is not involved, therefore we may proceed, with the hope that the patient is amenable to cure. Examination of the tumor itself shows that it involves the rectum at the peritoneal reflection. It is moderately adherent at the base of the bladder, and at one point shows on the peritoneal surface of the bowel, where it is obviously ulcerating through, but has not, as yet, involved any other tissue. We find that it is movable in the hollow of the sacrum, and we therefore conclude that there will be no difficulty in removing it. No lymph-nodes can be palpated.

The problem that now confronts us is to completely remove the growth and all the lymph-nodes draining it, even though they are not palpable; the three dangers that must be avoided are: first, undue shock from a too prolonged operative procedure; second, loss of blood; third, later sepsis from contamination and improper drainage of the large traumatized operative field. We therefore proceed in an orderly manner to avoid these specific dangers.

We first determine that by dividing the bowel about 5 inches above the growth we will be able to take out the segment of the sigmoid and rectum below it with all the regional lymph-nodes and will have an ample amount of sigmoid remaining to establish our left inguinal colostomy, which will be the permanent outlet for the fecal content. It is well known that any soiling from the sigmoid content is very prone to produce severe infection; therefore we avoid opening the bowel until the last step in the procedure. The mesosigmoid is divided on either side and reflected back laterally, after thoroughly protecting the rest of the abdomen with the pads. The sigmoid is then raised anteriorly, the superior hemorrhoidal vessel ligated at the point determined for section, and all other smaller blood-vessels are ligated at the same point. We have thus controlled completely all serious bleeding, much as is done after ligation of the uterine arteries in a hysterectomy. In fact, our procedure throughout is very analogous to this operation.

The lateral incisions in the peritoneum are now carried down to the Douglas pouch and anteriorly through this reflection, to expose the posterior surface of the bladder and the anterior surface of the rectum below the peritoneum. The dissection then proceeds on either side until the ureters are completely identified and exposed to their entrance into the bladder. The sigmoid is then raised from its posterior bed and the dissection is carried well down into the coccygeal hollow behind the rectum. We now lift the bladder, the seminal vesicles, and the prostate from their relation to the rectum. This, as you see, carries us well below the growth which is now completely mobilized, and we can follow the ureters into the bladder, so that we are sure that we have avoided damaging them.

The entire cancerous area with its lymph-nodes is now free from the point chosen for section down to the pelvic outlet. Since we are to do this operation in one sitting, it is important that the entire abdominal procedure be carried as far as this, otherwise our second step would prove unduly difficult.

We now proceed to make an ordinary intermuscular incision in the left flank for the purpose of establishing the colostomy. Next, the peritoneal floor is completely repaired except for the point through which the rectum still passes, around which a purse-string suture is placed for later tying. The bowel is now divided between two crushing clamps with the cautery—every care being taken to prevent soiling—and is burned close to the bite of the clamp. Each end is closed with an inverted purse-string suture, and the proximal end is passed out through the opening made for the colostomy and anchored at that point. The distal end is dropped into the pelvic cavity below the repaired peritoneum and the purse-string suture tied, thus completely closing off the peritoneum from the portion of the bowel to be removed. You will see that we have thus avoided two of the dangers, first, hemorrhage; second, soiling from the bowel content, as the bowel was opened only at the very conclusion of the operation under every possible precaution.

The abdominal wound is now repaired in its normal relations and, since the patient's condition is entirely satisfactory, we will take pains to carefully suture it, using for the most part chromic gut, with silkworm-gut for the skin, which also reinforces the fascial suture. We have so far taken an hour and a half for the operation. Our patient is in good condition, and as the remaining procedure will not require more than fifteen minutes we may immediately proceed to it.

The patient will be placed in a very exaggerated lithotomy position, so exaggerated that the plane of the perineum is horizontal and very considerably elevated above the body. This makes our procedure very much easier and at the same time prevents loss of blood from venous oozing. A sound is passed into the bladder. An incision starts in the midperineum, passes backward, encircling the anus on either side (which has been closed with a purse-string suture so as to prevent soiling), and is carried backward beyond the coccyx. The incision is deepened anteriorly until we reach the urethra, laterally until the levator ani muscles are encountered, and posteriorly into the coccygeal hollow. With blunt dissection you now see that it is an easy matter to pass upward until we come into the hollow of the sacrum, where we find lying the bowel already loosened from above. My finger now exposes the prostate, which, as has already been stated, was dissected free from the rectum in the abdominal section. I now grasp the free bowel from above and have the growth in my hand, and by gentle traction it can be drawn entirely out through the perineal wound. There are only one or two lateral blood-vessels passing near the levator ani muscles at this point which it is necessary to clamp and ligate. The final dividing of these attachments frees the entire rectum, and we have the large subperitoneal cavity widely open before us. This we will wash out thoroughly and then pack loosely with well-vaselined gauze, which will be sufficient to control the oozing and allow the escape of any septic material, and can easily be removed in forty-eight hours, after which the whole cavity will be irrigated daily.

The operation is finished under two hours and the patient's condition is very satisfactory.

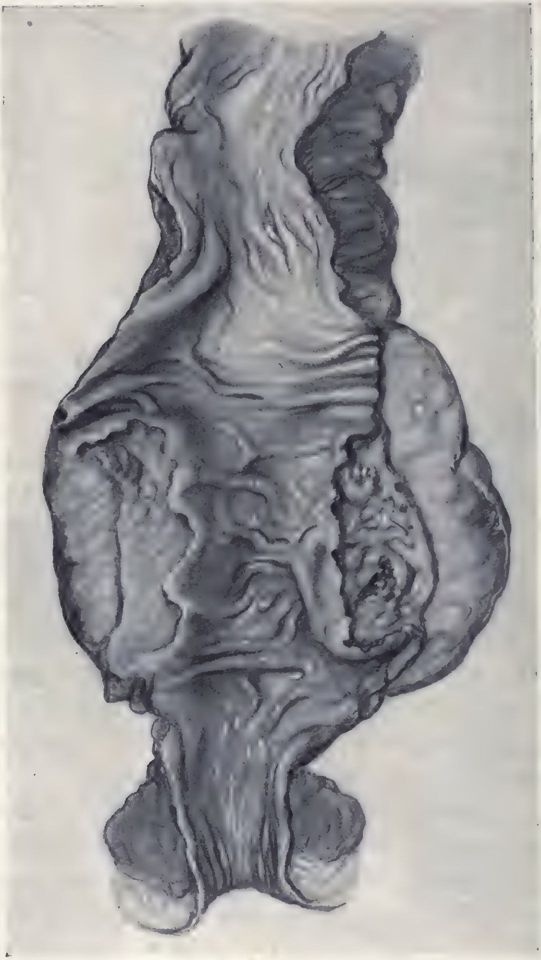

Fig. 142.—Cancer of the rectum. Sectioned through the middle of the growth longitudinally. Note the uninvolved portion of rectum in central portion of figure.

In this instance I shall now open the colostomy and insert a large tube into the bowel to establish immediate drainage, because it is noted that there is a very considerable amount of intestinal blocking due to the imperfect emptying of the feces previously.

Examination of the specimen shows you the ulcerated crater with the muscularis and peritoneum involved, as already stated (Fig. 142).

It may be of interest to you to discuss the advisability of doing this operation in two sittings. The operator is strongly of the opinion that where possible it should be done in one sitting. We have had a considerable number in this clinic and have always been able to conclude the operation within two hours, and in no case has the patient been in undue shock. When done at two sittings we feel that there is always the possibility of severe sepsis arising from the portion of the bowel that has been freed and placed in the subperitoneal sacral hollow. In spite of every care, there will be sufficient contamination of this seriously traumatized area to allow a very serious infection, particularly as many of these cases come to operation only when the cancer has ulcerated a considerable distance through the bowel wall. Such a condition in a more or less debilitated patient is ideal for the development of a septic state in the interval between the first and second stages, and, as before stated, one of the great dangers to these patients is sepsis. If done at one stage, as here illustrated, the lower cavity is widely drained and this danger is avoided. In case, however, for any reason it is deemed necessary to do the two-stage operation, I must caution you against carrying the dissection of the first stage as far downward as was done this morning. This will inevitably result in too great a denuded area, so that without the lower drainage the probability of serious sepsis is too great to risk.

The microscopic examination showed the lesion to be an ulcerating malignant adenoma. No lymph-node involvement could be found.

Subsequent Note.—The postoperative course of this patient was very satisfactory. The anterior abdominal wall healed, except for the skin, *per primam;* the colostomy functioned nicely, and in ten days the posterior wound was a clean granulating surface, which will close within a month or six weeks. Since the growth was adequately removable and no lymph-nodes were involved the permanent prognosis is more than fair. Malignant adenomas are, as a rule, not distantly metastatic and complete local removal gives hope of a permanent cure.

NON-TUBERCULOUS INFLAMMATION OF THE CECUM

The second patient for operation this morning is a boy aged fourteen whose history and examination suggest, but fail to positively determine, the diagnosis. The only symptom from which he has complained is that of mild recurrent attacks of abdominal pain during the previous year. In general, this pain seems to center in the region of the appendix, but has never been severe enough to confine him to bed until the present attack, which began four days ago. This has been rather more severe and has been accompanied by vomiting on one or two occasions, but there has been no irregularity of the bowel.

The patient is an Italian; as you see, of rather frail build, and possibly what we recognize as a tuberculous type. His temperature has not been elevated above 99.5° F. during his three days' stay in the hospital. His leukocyte count is 17,000, with 66 per cent. polynuclears.

The physical examination reveals entirely normal conditions except that the abdomen shows some general rigidity, very moderate, however, in amount, and tenderness on deep palpation in both lower quadrants; but rather more marked on the right. A sensation of doughiness is noted as being present on palpating the abdomen. There is believed to be a mass in the region of the cecum, but this has not been definitely made out. Because of the chronic course of the disease, the doughy sensation, the boy's nationality and general appearance, the diagnosis of tuberculosis of the cecum has been suggested rather than a simple appendicitis, and therefore I shall make an incision which will permit a more radical operation if this proves to be the case.

Palpation under ether reveals a rather definite mass which is movable, and I believe strongly tends to confirm the diagnosis. We will make the same incision as was used on the first case, except that it will be done upon the right side. This gives us free access to the cecal region without undue retraction, and permits us to lift it with the appendix into view. You note that the appendix is a rigid, erect organ, very much thickened, shows the evidence of a chronic inflammatory process, and near the base you may note a chronic perforation. There is, however, absence of suppuration in the surrounding tissue, and the cecum is very markedly involved in the process. The lymph-nodes in the mesentery of the ileocecal junction are enlarged and succulent.

We are now presented with a pathologic problem of difficulty. This condition may be due to tuberculosis or simply to pyogenic infection. Obviously, the disease has involved the greater part of the cecum, the wall of which is thickened I should say nearly ½ inch. It is very hard. There is absence of any evidence of tuberculosis in the rest of the peritoneum. We particularly note the absence of miliary tubercles on the peritoneal surface.

This lesion may occur as the result of ulceration in the cecal mucosa of non-tuberculous as well as of tuberculous character. The question therefore arises: Will this boy recover if we remove the obviously diseased appendix and trust that there is no ulceration within the cecum, but that the cecal involvement is pyogenic in origin and will resolve if the appendix be removed? It will not do so, of course, if the tubercle bacillus is the exciting cause. All things considered, I am inclined to believe that the best procedure is a removal of the entire cecum, adjoining ileum and colon, and will therefore proceed to that operation.

For this purpose it has been amply demonstrated that it is wiser to remove all of the colon that has not a well-developed mesentery, which means usually (and does in this case) up to the hepatic flexure. We may then do anastomosis between the ileum and the colon in a portion of the latter well provided with peritoneal covering, which will aid materially in closing the sectioned end of the colon and making a lateral anastomosis. The incision, therefore, will be carried upward sufficiently to expose the hepatic flexure, still preserving the abdominal wall, as mentioned in the previous case. The portion of the bowel to be removed is now mobilized by dividing the outer leaf of the mesentery and ascending mesocolon, which gives us ready access to the blood-supply of the part of the bowel to be removed. These blood-vessels are now clamped, the bowel is lifted forward and inward, the inner mesenteric leaf is divided, and thus we lift the entire cecum, ascending colon, and about 4 inches of the ileum outside of the abdominal cavity.

The peritoneum is now thoroughly protected, and the bowel is divided 3 inches from the ileocecal valve and again at the hepatic flexure. You note that I am dividing the bowel in this case with the knife rather than with the cautery, and that my protecting clamps are not tightly compressed. I believe that these steps are important because a cauterized bowel does not seem to me to heal as kindly and firmly as when sectioned with the knife. We will now close the open end of the bowel by an overwhipping stitch of chromic catgut and a further inversion under three layers of chromic gut inserted after the method of Lembert. It is of the utmost importance that great attention be paid to the closure of these blind ends of the bowel, since they are very prone to leakage. A side-to-side anastomosis is made by the usual method, as employed in gastro-enterostomy, with the blind end of the ileum and the colon both pointing toward the right. The stoma, as you see, is about 1 inch in diameter, and so far as can be determined we have accomplished a complete closure so that no leakage should take place. Of this, however, my experience does not make me very confident, as I have seen a number of cases in which leakage did take place when the large bowel was involved, even though every care was taken to avoid it.

We will now close the posterior peritoneum and place the omentum around the site of the anastomosis, thus leaving the intra-abdominal contents as nearly normal as our operative procedure will permit. The abdominal wall is closed by the same method as used in the other case, without drainage except in its superficial part, trusting that if leakage does occur it will find its way along the omentum to the surface or will wall itself off in such a way that a future drain may be used. The reason for adopting this course is that any drain, to be efficient, must necessarily lie close to the anastomosis or the closed ends of the gut. If by chance the drain comes in contact with the suture line, it undoubtedly tends to aid leakage, therefore we feel safer in not employing it.

The specimen, as you see, shows the condition already described (Fig. 143). On opening the appendix it is seen to be tremendously thickened and is necrotic at its base, with the chronic perforation already mentioned. There is nothing that proves that this case is tuberculous, and there is no ulceration inside of the cecum, though, as you see, the disease involves its wall over a very considerable area. We shall have to wait for the pathologic report to decide the question as to the etiologic factor.

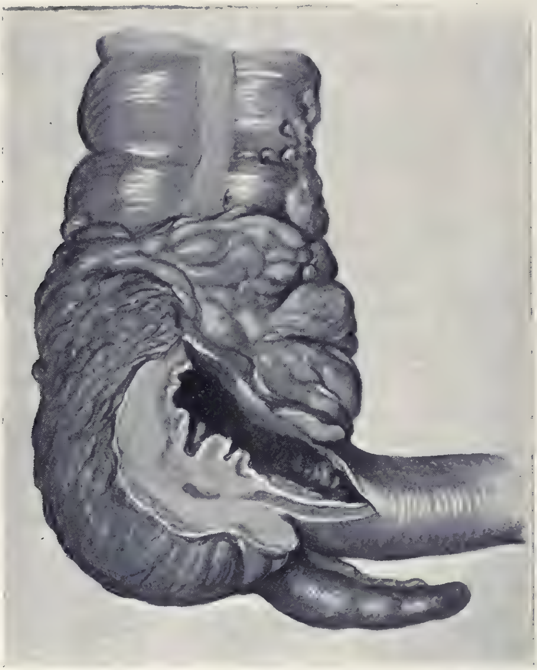

Fig. 143.—Lesion involving the appendix and the cecal wall. Note the extensive fibrosis which failed to reveal evidence of tuberculosis. All the coats were involved.

Subsequent Note.—Very careful examination of the cecum and the appendix failed to give any proof of tuberculosis. The process was a chronic inflammatory one without the formation of tubercles or giant cells; but even with this we believe it unsafe to say that the case is not tuberculous because—as amply shown in the literature—many of these cases later develop a tuberculous peritonitis or more extended section proves some spot in which the tubercle bacillus has been active. The German authorities are inclined to believe that there is a tuberculous element in all cecums of this type.

This patient did develop a fecal leakage, which, as we had hoped, readily found its way along the omentum to the abdominal wall and drained outward through the wound. It remained open for about eight weeks, with very moderate leakage, and spontaneously closed.

CHRONIC GASTRIC ULCER

Our third patient is a woman aged forty-seven who presented herself with the typical history of gastric ulcer, which is confirmed by the x-ray findings as shown on this plate (Fig. 144). The defect as seen by the fluoroscope is here demonstrated in the middle portion of the lesser curvature and is of very considerable extent, reaching upward toward the cardia.

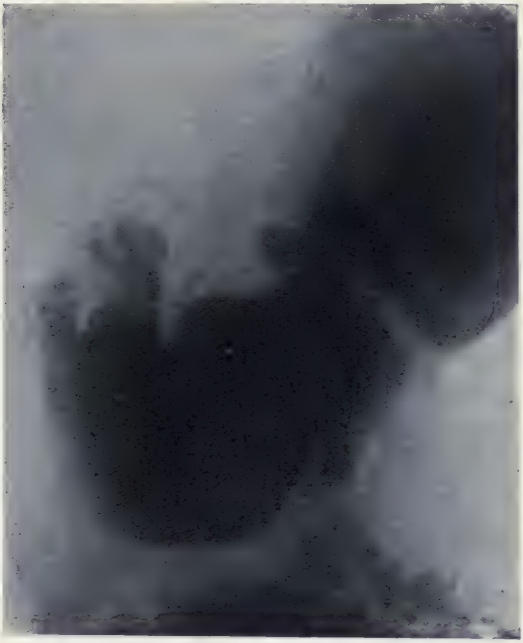

Fig. 144.—Filling defect with permanent incisure opposite to it. Note the high position of the ulcer on the lesser curvature.

For the approach of this lesion we will use the same incision as in the two previous cases, except that I shall go through the left upper rectus because I anticipate greater difficulty near the cardia than at the right end of the stomach. The lesion here is well demonstrated and, as you see, involves an area on the lesser curvature about 3 inches in extent, passing on to both the anterior and posterior walls. It reaches to the vertical portion of the cardiac end of the lesser curvature. Of course, cancer cannot be excluded, but the history (lasting over a long period), the patient's general condition, the localized nature of the lesion, all point to non-malignancy.

The problem before us is as to the best type of operation. There are three courses open to us: we may either excise the ulcer and repair the defect, or we may do a so-called sleeve resection of the central portion of the stomach, including the ulcer; or we may do a subtotal gastrectomy. The pros and cons of these procedures are fairly well established, but still admit of very considerable discussion. If a simple excision of the ulcer be done, there will be great difficulty in closing the most proximal portion of the lesser curvature, as it is rather inaccessible. Moreover, the repaired stomach will be greatly deformed, and there is a good deal of evidence that excision of this portion of the stomach with local repair results in a serious motor disability of the stomach. The ultimate result, therefore, may be a badly functioning organ which even a gastro-enterostomy will fail to totally obviate. Further, there remains behind a portion of the stomach which may be the seat of subsequent ulceration, and, of course, if the lesion prove to be malignant we have failed to cure our patient. For these reasons this operation does not seem advisable here.

The sleeve resection is fraught with too much operative difficulty, as it will be almost impossible to make a perfect end-to-end closure so far up on the lesser curvature. Therefore we shall proceed to do a subtotal gastrectomy. This will be the easiest of execution, and I believe involves less risk to the patient, and it will have the great advantage of removing both the ulcer and the ulcer-bearing portion of the stomach. The resulting condition has proved to give an exceedingly good function, and is probably less liable to gastric disturbance than the less radical procedures discussed.

This operation proceeds on well-established lines. The gastrohepatic and gastrocolic omenta are opened; the blood-supply of the portion to be removed is clamped; and, as you now see, the stomach is mobilized. The difficulty lies in the highly situated cardiac lesser curvature, and in order that this may remain well within our reach I shall anchor it with this simple stitch before placing my clamp and excising the stomach. Now, by placing one clamp just distal to the pylorus and a second one on the portion of the stomach to be left, the intervening part of the stomach is excised. We may now proceed to the re-establishment of the gastro-intestinal tract, either by closing the duodenum and the open end of the stomach and then doing a gastro-jejunostomy; or we may do the gastrojejunostomy after the Polya-Reichel method, using a portion of the open end of the stomach for the anastomosis; or by the method recently advocated by Moynihan, in which the anastomosis is made between the whole open end of the stomach and the side of the distal segment of the jejunum, which is sectioned about 8 inches from the pylorus and its proximal open end implanted laterally into the distal segment about 3 inches beyond the gastrojejunostomy opening. Moynihan thus avoids the possibility of a vicious circle and has the drainage of the bile and pancreas into the jejunum without passing above the anastomotic stoma. This he believes to be a distinct advantage, but it is obviously a considerably greater operative procedure.

In this instance the best procedure seems to be the first named, and I am, therefore, closing the stomach with a lock chromic gut stitch for hemostasis, and reinforcing this with the usual overlying peritoneal stitch. The end of the duodenum is similarly closed. The jejunum now rises close against the stomach, as you see, but will pass more easily if it is drawn through the transverse mesocolon, as thus illustrated. The mesocolon is now stitched firmly to the stomach wall and enough on the stomach so that the anastomosis lies well below. The anastomosis, as you see, is done in the at present accepted method of an internal lockstitch of chromic gut reinforced with a peritoneal chromic gut stitch. The resulting stoma lies slightly on the anterior wall of the stomach, which seems to give the most satisfactory anastomosis, and is sufficiently large to admit two fingers.

Our closure of the stomach wall at that difficult point on the lesser curvature has been very satisfactory, which seems to justify the adoption of the method followed. The abdominal wall is closed in the method already described, and no drain is used.

The specimen (on turning it wrong side out, as you see) reveals the ulcer corresponding exactly to the *x*-ray findings. It has perforated through to the peritoneal attachment of the lesser curvature, and there is an extensive area of induration surrounding it. On section, however, it lacks the characteristic appearance of malignancy, and will probably fail to show cancer under the microscope.

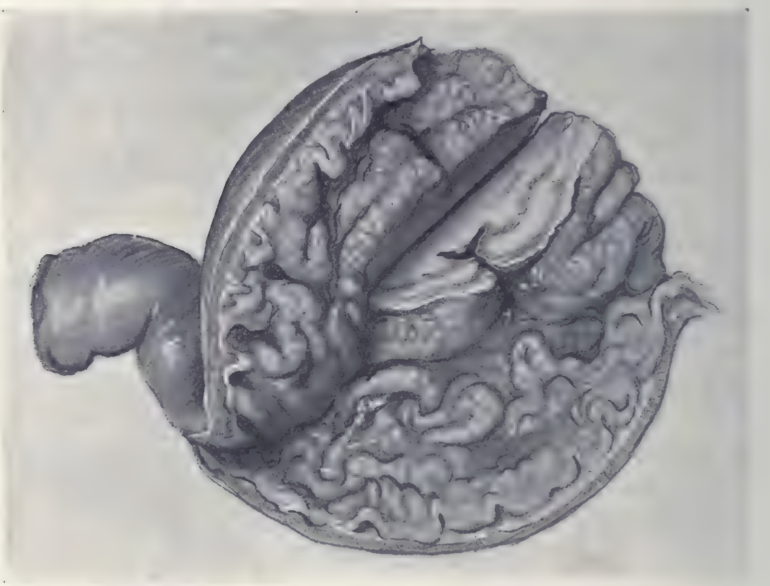

Fig. 145.—Perforating gastric ulcer showing penetration and craterlike formation through all the coats. Note extensive thickening and the amount of stomach removed.

Subsequent Note.—Microscopic examination later proved the lesion to be a simple ulcer, with no evidence of malignancy. The patient's convalescence was without incident of any kind, and an x-ray examination at the end of three weeks shows the stomach functioning well and the stoma draining from what now is apparently the most distant and dependent portion of the stomach (Fig. 146). This confirms the statement already made that, as a rule, subtotal gastrectomy leaves a very satisfactorily functioning organ.

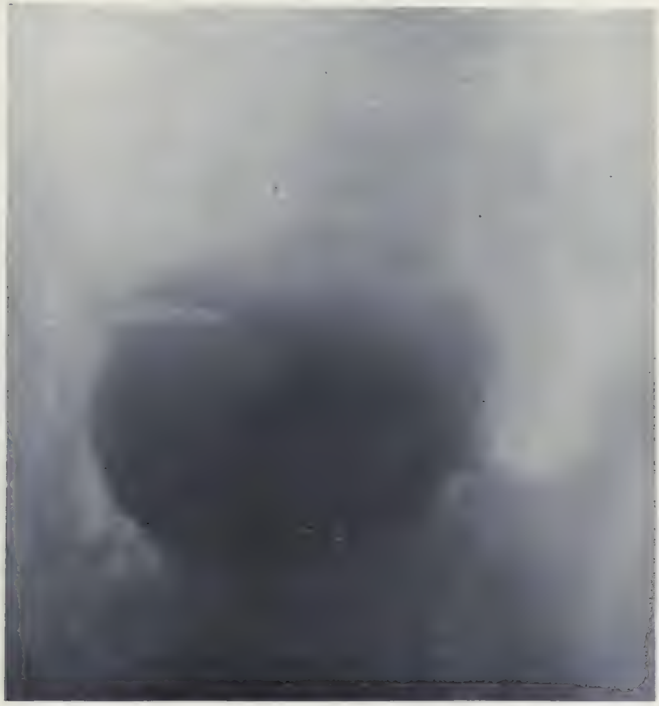

Fig. 146.—After subtotal gastrectomy. Note the extent to which the stomach has dilated as a food reservoir. Emptying is complete in the normal time.

CLINIC OF DR. ALLEN O. WHIPPLE

PRESBYTERIAN HOSPITAL

SURGERY OF THE BILIARY TRACT

Cases for Postoperative Discussion: I, II, and III. Case for Operation: IV.

CASES FOR POSTOPERATIVE DISCUSSION

Case I.—J. G., male, fifty-eight. History No. 49,139. Admitted November 22, 1920.

Chief Complaint.—Discharging abdominal sinus. Pain in right upper quadrant.

Past History.—He was operated upon twenty years ago for gall-stones. A large stone was removed. Gall-bladder was drained. No history of typhoid. Lues denied. Neisser infection thirty years ago. Following the operation he remained well and free from digestive disturbance for seventeen years.

Three years ago he began to have discomfort in the region of the scar and noted a gradually increasing swelling in the scar. In May, 1920 he was operated upon for repair of a ventral hernia. There was a moderate infection of subcutaneous tissue of the wound, but it healed without impairing the hernia repair. Three weeks after the wound had closed two sinuses developed. One of these persisted and discharged intermittently mucous and at times calcareous material.

For six weeks preceding his last admission to the Presbyterian Hospital he had been having attacks of cramplike pain in right upper quadrant, radiating to right scapula. These attacks were accompanied by no vomiting, but belching of gas. Bowels were not clay colored. No jaundice. No loss of weight.

Physical Examination.—A well-nourished, rather obese man of middle age. He did not appear to be ill. Color good. No jaundice of scleræ or skin.

Pupils: Unequal, right pin-point, and did not react to light.

Tongue: Moist, coated.

Teeth: In poor condition. Moderate pyorrhea.

Heart: Normal.

Lungs: Normal.

Abdomen: A scar was present, oblique, 19 cm. long parallel to the costal margin; 8 cm. from its right extremity a fistulous opening was seen discharging a mucopurulent material. The discharge increased with pressure under the costal margin in midclavicular line. Here there was a moderate tenderness on deep palpation.

Knee-jerks: Active and equal. No Romberg. No ataxia.

Laboratory Findings.—Wassermann reaction negative in both antigens. W. B. C. not elevated.

Duodenal intubation unsuccessful because of hyperesthetic pharynx.

x-Ray examination, with opaque catheter in the fistulous tract, showed the catheter passing upward and to the midlinef No shadows of calculi were seen. A probe, passed a distance o. 10 cm., gave a gritty feel.

The points of interest and those to emphasize in this case are:

1. A cholecystostomy with freedom from symptoms for seventeen years.

2. Recurring symptoms of distress in right upper quadrant with development of hernia. At the time of the second operation—the one for hernia repair—the operating surgeon recorded in the history that there were numerous old adhesions between anterior parietal peritoneum and the gall-bladder, *i. e.*, a marked pericholecystitis. But every effort was made to avoid traumatizing the gall-bladder. The removal of it then was not considered, inasmuch as the purpose of the operation was hernia repair and primary union. Nevertheless, probably as a result of latent infection in the severed adhesions, some infection occurred. But this cleared up, to be followed later by the appearance of a fistula in the scar.

3. Appearance of gall-stone colic for six weeks preceding the last admission, typical in type and radiation of pain.

4. Irregular pupils, but active knee-jerks. Absence of ataxia. Negative Wassermann.

With this history and these clinical findings a definite diagnosis could be made with positive assurance that it would be confirmed at operation. There are many biliary conditions where it is impossible to make a flat diagnosis, but in a case of this type the correct one should always be made.

DR. WHIPPLE: What lesions did he have?

STUDENT: Chronic cholecystitis with fistulous opening.

DR. WHIPPLE: What kind of a fistula would you call it ?

STUDENT: Mucous fistula.

DR. WHIPPLE: That is correct. Not a biliary fistula. What is the origin of the mucous fistula?

STUDENT: The gall-bladder.

DR. WHIPPLE: Exactly. Here was a case of persistent mucopurulent fistula with absence of bile in the discharge and absence of jaundice. He presented the factor of obstruction and the factor of infection, in combination, and illustrates in an ideal manner the principles underlying the lesions of the biliary tract as we discussed them in conference. Where would you localize the obstruction, and what might cause it?

STUDENT: Scar tissue in cystic duct.

STUDENT: Gall-stone impacted in cystic duct.

STUDENT: Adhesions about the duct.

STUDENT: Catarrhal inflammation of the duct.

DR. WHIPPLE: I suppose "catarrhal" is an allowable term, but it is a terribly abused word, and I should avoid it in medicine. The first two causes given are the most common, *i. e.*, causes in the lumen and in the wall of the duct. Causes outside of the duct can be ruled out. With regard to adhesions about the duct, it is my impression from hearing some of your discussions in conference that many of you have an erroneous idea of or a nebulous idea of adhesions outside of such structures as the cystic and common ducts. These ducts do not kink easily and scar tissue has to involve the actual wall of the duct to cause obstruction. The term "adhesions," like "catarrh," is an abused one, and should be used intelligently. Edema of the duct would not act over so long a period. When obstruction is caused by mucosal edema it is usually only temporary.

The purulent character of the mucus and the tenderness over the gall-bladder region implied infection of the gall-bladder. The gritty sensation transmitted by the probe indicated gall-stone, as did the history of passing calcareous material by the fistula. The absence of gall-stone shadow meant nothing. The diagnosis of gall-stones should never depend upon their appearance in the *x*-ray plate.

Therefore, obstruction in the cystic duct, due either to stone or scar tissue, a chronic inflammatory process in the gall-bladder, uninvolved common duct, were the findings to be expected, and the history shows the preoperative diagnosis, given just before beginning the incision, was: mucous fistula of gall-bladder; chronic cholecystitis; cholelithiasis; stone in cystic duct.

The write-up of the operation is as follows: The scar in the right upper quadrant showed a good hernia repair, no recurrence; fistulous opening was present in the scar. A catheter was passed through this opening and, on opening the abdomen, was found in gall-bladder. Situated in the ampulla and blocking the cystic duct was a large cylindric gall-stone 3 x 1 cm. in diameter. Its proximal end lay flush with the common duct. At the area where the gall-bladder was adherent to the colon the tissue was hard, necessitating a submucous dissection of gall-bladder at its distal half.

Before the operation the incision was discussed in the pre-operative note. I consider the reversed L-shaped incision the best in cases of this type, *i. e.*, secondary cholecystectomies, in order to approach the ducts through free peritoneum. That is a surgical principle that is wise to follow in any secondary operation. It is always easier to approach a diseased abdominal viscus in a secondary operation through uninvolved peritoneum than through scar tissue. The exposure afforded by this incision gave us easy access to the ducts. The impacted stone in the cystic duct presented another interesting point. It was a large cylindric stone, as you see, which impinged upon the common duct. If a clamp had been applied it probably would have slipped off and included a part of the wall of the common duct. To avoid this an incision was made over the ampulla, the stone was drawn out of the cystic duct, and a ligature was then tied over the duct. The cystic vessels were tied separately, as they should be in all cases, and the ligature carrier should be passed out toward the gall-bladder rather than to the midline toward the duct. The gall-bladder was then removed. The common duct was not dilated, no stone was felt in it, and the pancreas was not indurated around it, so it was not opened or drained. A rubber tube was placed down to Morrison's pouch.

Following operation, on the second day, he began to show bile in his dressings. Evidently the ligature had cut through his scarred duct stump. This takes place in a fair percentage of cases. In such cases, there being no clot in the stump and as there is pressure of bile in the common duct, the escape of bile is logical. The drain cares for this and is, therefore, indicated in every cholecystectomy.

He has had two complications of considerable importance and frequency in biliary cases. He vomited frequently for the first forty-eight hours and he had hiccup. The vomiting was controlled by a hot lavage and by what we call "gastric tolerance diet"—very little diet to be sure. The patient is given 1 dram of chloroform-water, freshly prepared, followed in ten minutes by $\frac{1}{2}$ ounce of peptonized milk. This is repeated every hour up to four doses. If vomiting has ceased, the peptonized milk is increased to 1 ounce every hour. After that chloroform-water is stopped and the patient is put on gradually increasing amounts of fluids without milk, *i. e.*, albumen-water, broth and sour milk, prepared with lactic acid bacillus. His hiccup was relieved by letting him take a teaspoonful of chloroform-water whenever he showed a tendency to hiccup. But, understand, a measure that will relieve one patient of hiccup may have no effect on another. Unfortunately, there is no specific for hiccup. Each case has to be treated individually in that regard.

This is now his eleventh day after operation. His temperature is normal and his biliary discharge is lessening, though still free. The biliary fistula should close in another four or five days.

Case II.—C. M., female, single, age fifty-one. History No. 48,089. Admitted to the Presbyterian Hospital November 16, 1920.

Chief Complaint.—Pain in the right upper quadrant.

Past History.—Rheumatic fever as a child. No history of typhoid. No pregnancies.

Present Illness.—Began one year before admission with symptoms of indigestion. Four months later she had her first attack of right upper quadrant pain with vomiting. The pain was severe and localized. Subsequently she had several similar attacks, sometimes followed by jaundice. She was first seen in the Out-patient Department in September, 1920. Examination then showed tenderness in the right upper quadrant, none in right costovertebral angle. Stomach and urinalysis, fluoroscopic and radiographic studies showed no abnormalities. One month later, in October, she was examined, and right costovertebral angle tenderness and pus in urine were found. Cystoscopy showed turbid urine coming from the right ureter which microscopically showed pus. She was given urotropin, with clearing of her urine.

On November 16, 1920 she came to the hospital in great distress and looking acutely ill. Pain was present in right flank and in right upper quadrant. No radiation. Tenderness was marked over right upper quadrant and a mass could be made out in gall-bladder region. Some tenderness in right costovertebral region. Her skin was slightly jaundiced. There was moderate edema of the ankles. Heart sounds were irregular and muscle sounds of poor quality. Lungs emphysematous.

Temperature, 104° F.; pulse, 120; respiration, 24; W. B. C., 18,000; Polys., 82.

Urinalysis.—Few hyaline casts and scattered W. B. C.; bile present. No glucose.

Duodenal Tube Findings.—Bile and pancreatic ferments present. Culture showed a Bacillus proteus.

She was observed for two days. Her tenderness and mass decreased rapidly in right upper quadrant. Temperature fell to normal. Jaundice persisted. x-Rays of kidneys and ureters were negative.

Dr. Whipple: What diagnoses do you think were considered?

Student: Common duct stone.

Student: Pyelitis or perinephritic abscess.

Dr. Whipple: If it had not been for the previous history of pain in right upper quadrant associated with jaundice, together with persistent though mild jaundice for the two days before operation, the urinary findings and cystoscopic examination in the Out-patient Department, and the costovertebral and right flank tenderness on her physical examination would have favored a kidney lesion, a pyelonephritis with perinephritis, rather than a biliary tract lesion. But the history of attacks of pain in right upper quadrant, pain followed by temporary jaundice, and the tenderness in right upper quadrant with deepening jaundice after admission, made the diagnosis of cholelithiasis, with calculi in gall-bladder and common duct the logical diagnosis. Let me emphasize again the relative value of jaundice as a factor in diagnosis of upper abdominal lesions. Its absence in no sense rules out gall-stone disease. Its presence, especially if intermittent and following right upper quadrant or epigastric pain, is almost pathognomonic of cholecystitis and cholelithiasis. This should be self-evident if you remember that the presence of jaundice is dependent upon the site of the obstruction in the biliary tract. The patient had a leukocytosis, marked tenderness in right upper quadrant, and right rectus spasm. What would that indicate?

Student: Acute infection of the gall-bladder.

Dr. Whipple: Unquestionably an acute infection or an exacerbation of an old infection. Do you think the acute infection involved the common duct? Did she have an acute cholangitis?

Student: Probably not. There were no chills and spiking temperature.

Dr. Whipple: One would expect more reaction with a cholangitis. In this case we also thought of a pancreatic lymphangitis following an acute cholecystitis. And because of the incomplete common duct obstruction this was considered as probable a diagnosis as common duct stone by two of the staff men.

On account of her age, her emphysema, her weak heart muscle, and her kidney findings she was considered a poor risk. But her repeated attacks of jaundice and her recent acute attack made operative treatment imperative. A general anesthetic was contraindicated. The exploration, the cholecystectomy, and choledochostomy were all done under local novocain anesthesia. The patient co-operated remarkably well.

The gall-bladder showed a very marked chronic inflammation with gall-stones, but not so much evidence of recent acute inflammation as one would expect from her signs and blood count. The common duct contained several pigmented stones. There were three large stones averaging 1 cm. in diameter. Why she did not have more obstruction is difficult to say. The pancreas around the terminal common duct was indurated and thickened, causing some narrowing of the duct.

The patient has done wonderfully well, very much better, I am sure, than if she had had a general anesthetic. Of course, operating under local anesthesia requires more time and effort than under general anesthesia—one hour and forty minutes in this case. But the patient's pulse did not go over 76 at any time during the operation and her subsequent course has been remarkably smooth. She has had no temperature above 100.4° F. Her pulse has not risen above 84, she has had no fibrillation, due probably to digitalis therapy. Now on her fourteenth day she has a firmly healed wound with a small granulating tract at the site of the drain. The biliary fistula closed on the twelfth day.

The interesting features of this case are the facts that although she had so many calculi—three large stones in her common duct—and although she had quite a bit of pancreatic involvement around her common duct, she showed only slight jaundice. Also that the gall-bladder did not show as much acute inflammation as one would look for. Finally, the advantages of local anesthesia in a patient showing heart, lung, and kidney involvement.

Case III.—Female, married, age forty-four. Admitted to the Presbyterian Hospital October 14, 1920.

Chief Complaint.—Attacks of pain in right upper quadrant.

Present Illness.—For past ten years she has been having irregular attacks of right upper quadrant pain with vomiting. Pain has sudden onset, is colicky, situated in right upper quadrant, lower thorax, and between the shoulders. These attacks have not been associated with fever or jaundice. She has chilly sensations at onset, but no chill. The last attack occurred five days before admission, and has been more or less persistent ever since. There has been much bloating after meals.

Past History.—She has had eight pregnancies. No history of typhoid. Severe bloating and belching for fifteen years. Born in Italy. In United States sixteen years.

Physical Examination on Admission.—A frail, middle-aged, Italian woman in great pain. No jaundice. Temperature, 101° F.; pulse, 108; respiration, 24; W. B. C., 20,000; polys., 82. The abdomen showed a globular mass in right upper quadrant extending 1 cm. below umbilicus, which was tender, hard, very near anterior abdominal wall. There was muscle spasm in right rectus. The mass was movable from side to side, and gave sense of ballottement.

The remaining physical examination was negative except for relaxed perineum and lacerated cervix.

Dr. Whipple: This patient presents a very interesting case for analysis. Some of you know about her, for I discussed her case with one of the sections in the conference on common duct obstruction. I shall ask questions of the other section.

Because of the continued severe pain over a period of five days with the failure of the tender mass to subside it was thought wise to explore. I am indebted to Dr. Hanford for permission to present this patient. He had charge of her case and assisted at her first operation and performed the successful operation for relieving her common duct obstruction. The diagnosis before operation was given as either hydrops of the gall-bladder or acute cholecystitis. What do you think of the diagnosis of hydrops in a patient with that history?

STUDENT: I think that it was made chiefly on account of the movable mass.

DR. WHIPPLE: What in the history, would you say, was against hydrops?

STUDENT: The intermittent attacks would imply a chronic thickening with contraction.

DR. WHIPPLE: If such a movable mass were found in a young woman during or shortly after a pregnancy, hydrops would be more probable as a result of a sterile pure cholesterin stone in an uninflamed gall-bladder. This patient gives a history covering ten years, and that implies a chronic cholecystitis with non-elastic gall-bladder.

The points in favor of acute cholecystitis are: The extremely tender mass, the spasm of the upper right rectus—indicating peritoneal irritation, a pericholecystitis—and her temperature. The operative findings explain the enlarged gall-bladder. Here it is, but much smaller because of the formalin fixative. The walls are markedly thickened as a result of edema, and impacted in the neck is the single translucent pure cholesterin stone. The natural history of the patient's past ten years of gall-bladder trouble is before you in the specimen. This is a pure cholesterin stone, with bile-pigments at both ends, where it was in contact with bile in gall-bladder and cystic duct. Probably until recently this gall-bladder was sterile; the attacks of colic were caused by the stone becoming impinged in the duct and held in the ampulla. But lately, especially in the last attack, to the process of cystic duct obstruction was added the process of inflammation, resulting in the edema and dilatation, and the deposit of calcium-bilirubin salts on the free ends of the stone. I believe from her history and the stone that she did not have her superimposed inflammation until the last attack.

Following her operation the history is exceedingly interesting. She developed a complication which is always very trying in biliary surgery and not uncommon, *e. g.*, a pneumonitis. It was typical in its onset within forty-eight hours after operation. Temperature dropped by lysis. Mouse sputum inoculation showed a Pneumococcus IV. This is the most common type in postoperative pneumonia. In some hundred cases studied in this hospital in 1914 to 1917 we found the Pneumococcus IV in over 60 per cent. of the sputa.

Shortly after operation, on the third day, bile was noted on her dressings. The scleræ and skin showed jaundice on her fourth day. Stools appeared clay colored on the sixth day. From this time on for three weeks she became progressively jaundiced. A very puzzling feature was that the bile which had been abundant in the dressings stopped flowing on the sixth day and the fistula closed. Duodenal intubation showed a colorless, alkaline duodenal content, with active pancreatic ferments, but no bile. She had no temperature. No chills. Her blood-clotting time rose steadily until before operation it was forty-four minutes.

The operator and the assistants were most emphatic in stating that the operation was uncomplicated. The structures in Callot's triangle—the cystic duct, common duct, and cystic vessels—had been easily visualized. The cystic duct and vessels had been ligated separately. No clamps were used. In every respect accepted technic had been followed. She presented a most difficult problem from the standpoint of explaining the cause of her jaundice and she was carefully studied by several of the attendings. Let me emphasize again that she had had an easy, uncomplicated operation, in which accepted technic was followed, practically eliminating the possibility of common duct injury or ligation. No stones were found in the common duct, she had had a biliary discharge from her wound from the third to the sixth day, when the fistula closed; her jaundice began to appear on the fourth day and continued progressively. If you think over these conditions in the problem you will be forced to one conclusion as to the pathology causing the obstruction. What would you say was the cause?

STUDENT: Pancreatic lymphangitis.

STUDENT: Stone in the duct.

STUDENT: Kink in the duct.

STUDENT: Cholangitis.

STUDENT: Spasm of the sphincteric muscle.

STUDENT: Fibrosis of the duct.

DR. WHIPPLE: The most common causes of common duct obstruction following operation are: first, stone overlooked; second, clamping or tying off the duct with resulting stricture. As regards stone in this case, the finding of a single cholesterin stone in the gall-bladder, with normal, undilated, common duct would almost surely rule it out. The observations of the operator and assistants were very much against stricture. But the one feature of the case which ruled out any cause below the cystic duct was the fact that for three days there was a biliary discharge. Any complete obstruction below the cystic duct would have caused a persistent biliary fistula. The process, whatever it was, had to involve the cystic duct level of the common duct, and must have involved that level subsequent to the establishment of the biliary fistula.

The operation revealed a very remarkable condition and one none of us has been able to explain. I assisted Dr. Hanford and am giving you the facts. A cicatrization of the entire common duct from the level of the papilla to a point at the junction of the hepatics—right and left—was found in the form of a band of scar tissue without lumen. What caused this we do not know. The fact remained and necessitated a radical means of re-establishing a channel for bile to reach the duodenum. To accomplish this a rubber tube was placed in an opening at the bulging junction of the two hepatic ducts and the other end was placed into an inverted opening of the second portion of the duodenum. Around this tube a peritoneal reflexion from the round ligament was sutured to the margin of the gastrohepatic omentum. In the process of dissecting the cicatrized common duct to try to find a lumen the portal vein was incised, but was successfully sutured with fine silk.

The patient stood the operation remarkably well. She had been given an intravenous infusion of 0.2 of 1 per cent. of calcium lactate, 300 c.c., before operation and had no oozing during or after operation. It is now twenty-three days since her operation. Her jaundice has cleared, she is having normally colored stools, her appetite is good. She is walking. She has no biliary fistula and has had none since the last operation. It is too soon entirely to call her cured. A year from now, if she passes the tube and is free from symptoms, we may consider her cured. Too many of these cases of common duct reconstruction are reported as cured within a month or two, and go down in the literature as such. The failures, even if subsequently reported, are not linked up with the previous premature reports.

CASE FOR OPERATION

Case IV.—M. H., female, fifty-two.

Chief Complaint.—Epigastric pain. Jaundice.

Present History.—Dates back two years, when she began to have severe epigastric distress, with bloating and belching after meals. At intervals of ten days to two weeks she would have severe tearing pain in the epigastrium. Six months before admission, after a severe attack of pain, she became markedly jaundiced for a period of four to five days. The jaundice cleared, but the distress persisted.

Three weeks before admission she had a severe attack of cramplike pain in the epigastrium, radiating around the costal margin, and focusing in the right scapular region. During the attack she had severe vomiting and tenderness in the right upper quadrant and epigastrium. A week later she developed jaundice, which has persisted, increasing in intensity, up to the time of admission. Pruritus has become very annoying.

Past History.—She had always been well up to two years ago. No history of typhoid. She has had sixteen pregnancies.

Physical Examination.—She is a well-nourished middle-aged woman. Skin deeply jaundiced. Temperature, 99° F.; pulse, 112; respiration, 24; W. B. C., 11,000; polys., 90. Heart and lungs negative.

The abdomen showed marked tenderness in the epigastrium.

Liver edge could be made out 3 cm. below the costal margin, and was tender. No muscular rigidity.

The Wassermann was negative. Blood cholesterin 2.3 per cent. Blood coagulation time thirteen minutes. Examination of the stool showed absence of bile. Duodenal intubation showed an alkaline, colorless, slightly viscid fluid, containing no bile. There was no response to $MgSo_4$ instillation. Culture of duodenal fluid showed a Staphylococcus albus and a Gram-positive bacillus—probably mouth contaminations.

Dr. Whipple: This patient presents as typical a history and physical findings as is possible for a clinic on surgery of the biliary tract. Her many pregnancies connoting a high cholesterinemia, the history of the past two years, her present history and physical findings and laboratory tests all point to a chronic cholecystitis with calculi in gall-bladder and common duct, probably also an associated pancreatic lymphangitis.

She has been under observation in the hospital for five days and because of persistent jaundice and absence of bile in the duodenum and threatening cholangitis she is to be operated upon.

The incision to be used is determined, first, by the type of operation intended, *i. e.*, as to whether or not the common duct is to be attacked, as in this case; and second, by the arc of the intercostal angle. For patients with a wide arch or intercostal angle, or in cases with flaring ribs, as in the old emphysematous male, the transverse or obliquely transverse incision gives the best exposure. Where the intercostal angle is narrow the vertical or hockey-stick incision gives an easier access to the gall-bladder, facilitating the rotation and exposure of the right lobe. A free exposure is essential in biliary tract operations; it saves time, insures access to a difficult and dangerous zone, and prevents blind work. In this patient, both because of the wide intercostal angle and the common duct obstruction, a generous oblique incision is used.

Hemostasis in jaundiced cases should be most carefully carried out; even the smallest bleeding points should be ligated. This precaution together with preoperative intravenous infusion of a 0.2 per cent. calcium lactate solution will prevent the distressing and sometimes fatal oozing after operation.

In cutting through or across the rectus muscle the vessels should be clamped before cutting to avoid retraction of the bleeding vessel into the muscle.

The liver is now visible. After separating the numerous adhesions between colon, duodenum, and under surface of the liver we find a very unusual condition. There is no bed in the under surface of the liver for a gall-bladder. What I took to be gall-bladder is a markedly dilated common duct containing several large gall-stones (Fig. 147). The vessels run transversely rather than in the long axis of the mass. There is no evidence of a cystic duct either inside or outside the common duct. On

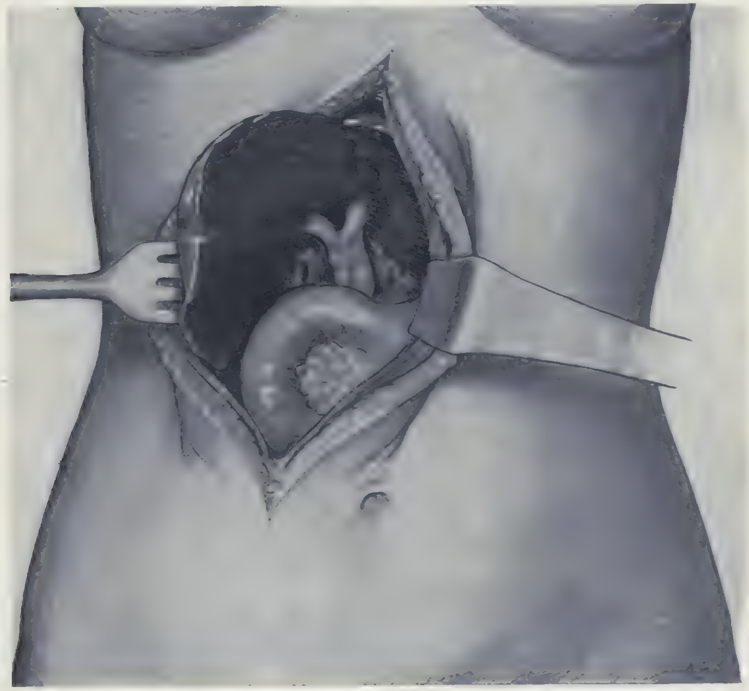

Fig. 147.—Sketch of the patient with common duct stones, without any evidence of cystic duct or gall-bladder.

opening into this structure these four large stones are found. They are dark brown in color, soft, crumble easily, rounded, non-facetted, that is, typical bile-pigment stones. The finger passes up easily to a bifurcation, one branch passing to the left, the other to the right, evidently the hepatic ducts. In passing down the duct obstruction is met at or near the papilla, but no gritty feel is elicited with the gall-stone forceps, and the obstruction corresponds to the thickened pancreas about the terminal end of the duct, *i. e.*, a moderate pancreatic lymphangitis.

In a case like this it has been my experience that if no grating feel is made out on gently probing with a blunt metal instrument it is wiser not to try to force a passage into the duodenum. If the common duct is properly drained, that is, for two to three weeks, the pancreatic swelling subsides and the lumen of the common duct is re-established.

In this case either the gall-bladder is a deeply placed intrahepatic one with a cystic duct communicating with one of the hepatic ducts or there is a congenital absence of the gall-bladder. Because of the absence of the cystic duct and vessels and because of the atypical arrangement of the right lobe and the Spigelian lobe I believe this is a case of congenital absence of the gall-bladder. This is the third case I have seen. In the first case I remember, an operation in which I assisted Dr. Peck, there was a congenital absence of the left lobe as well as of the gall-bladder.

We have sutured a rubber tube drain into the common duct, using plain gut. This drain will also be sutured into the skin to keep it in place for two to three weeks. I believe in prolonged common duct drainage in cases of pancreatic involvement. Another rubber tube drain is placed in Morrison's pouch to avoid a subhepatic collection of blood and bile, with possible later abscess formation.

In the closure it is essential to suture carefully the peritoneum and transversalis fascia or posterior rectus sheath. I use a locked stitch of continuous plain gut. Formerly I used mattress sutures in the cut ends of the cut rectus. This was an error, for the tension of the sutures caused necrosis of the muscle, everted the ends of the muscle, and favored a wide band of scar tissue. Now I use interrupted chromic sutures to bring the severed ends of the anterior rectus sheath into accurate approximation. No attempt is made to suture the cut ends of the rectus muscle. The scar in the skin of the transverse incision is certainly less noticeable than in the vertical incision. This is very evident in our follow-up cases.

CLINIC OF DR. FRED H. ALBEE

Post-Graduate Hospital

PLASTIC SURGERY OF THE HIP AND FEMUR

Case I.—W. W., aged five, while riding in a small wagon on the sidewalk, June 4, 1915, was accidentally overturned by an automobile backing out of a driveway, and his right femur was fractured at the junction of the upper and middle third. The leg was placed in a plaster-of-Paris cast, including hip and ankle; traction, by means of adhesive straps below the fracture and brought out through the sides of the cast, was applied and continued after the patient was transferred to bed.

On account of the apparent impossibility of keeping the ends of the fragments together (Fig. 148) an open operation was done on July 15, 1915. A fair-sized callus had formed about the bone ends, but had not bridged the gap because there was muscle to the thickness of ½ inch lying between the ends of the bone. A sharp superior fragment was displaced forward, overlapping about 1 inch.

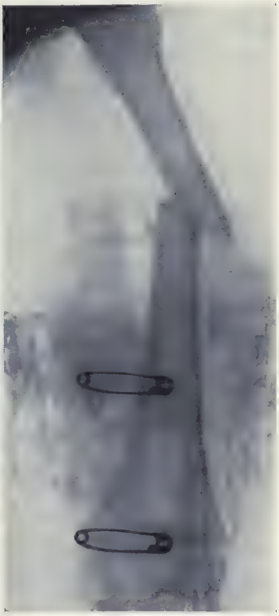
Fig. 148.

Studying the subsequent history of this case, it is believed that this surgical tragedy had its inception at this very juncture, because the methods used were not competent to remove the interposed muscle from between the fractured ends during the critical period in the union of the fractured bone. In other words, the callus was prevented from bridging the gap from one fractured fragment to the other during the first few weeks following the fracture, which is the most active osteogenetic period. The traction had overcome the shortening to a degree which would have hardly passed, but if union had taken place the limb would undoubtedly have been satisfactory for function. The muscle between the bone ends, however, prevented union. This frequent state of affairs can be prevented in a large percentage of cases only by early open operation, excluding the displaced muscle and bringing together the fractured ends. Naturally, this is not possible of accomplishment by purely tractional methods, neither of the skeletal type nor by the adhesive plaster used in this case. By the skeletal type of traction is meant thc Steinmann or Codivilla nail and the different types of tongs and stirrups.

It is believed that experiences in military surgery have often led to misunderstandings when the lessons there learned have been applied to civil practice. In France the large percentage of cases seen were not at all applicable to plaster-of-Paris or coaptation splints of any kind, and could be controlled only by traction applied at a distance from the extensively lacerated compound fractures in a position of neutral muscle pull, most effectively brought about by means of the development of the Balkan frame. By this means results were obtained which, while not ideal as compared with the results so frequently attained with simple fractures in civil practice, were nevertheless the best that could be secured under the circumstances and were functionally satisfactory in a large percentage of the cases. In civil practice, however, the problem is entirely different. A large majority of the fractures are of a comparatively simple type and more perfect results are demanded. If the closed method does not produce satisfactory results as measured by these higher standards, then a prompt decision should be made within the first few weeks following the fracture, and an open operation should be done, bringing the ends into close coaptation, and so holding them by the simplest procedure possible, using an absorbable material, such as kangaroo tendon.

When done properly it is believed that this is the most ideal method, in that the insertion of a non-absorbable foreign body with all its tissue-destroying properties is avoided, and, moreover, that the kangaroo tendon ligature does not interfere with the mechanical end-to-end thrust of one fragment upon the other, this being nature's most potent influence to promote active callous formation. In fact, the influence of mechanical stress of all kinds in promoting active osteogenesis cannot be overestimated. The lessons of the Balkan frame have proved still further the value of "posture of neutral muscle pull," and this must be made the most of in applying the external splint of plaster of Paris. Traction should never be applied if it can possibly be avoided when the fragments are secured end to end.

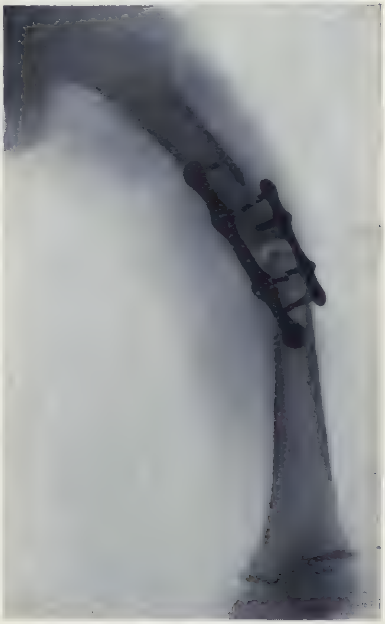

Fig. 149.

Operation (July 15, 1915): Two bone fragments were removed, perfect coaptation was secured, and approximation was obtained by a 3-inch Lane plate on the inner side and a 2-inch plate on the outer side. (Figure 149, which is a skiagram made

August 10, 1915. The screws have already loosened and are falling out of the bone. The fragments are in marked malalinement.) Following this operation the patient ran an uneventful clinical course, with temperature of 100° F. at the end of twenty-four hours, 99.6° F. at the end of forty-eight hours, and normal thereafter. When the cast was removed on August 22d the child was taken home to be cared for by his mother, who was a graduate nurse. Various observations were made. One month after the operation there was a large callus thrown out on both sides, with softening of the bone around the screws. On September 22d the Lane plates were removed from the right femur. The bone was seen to be apparently firmly united and slightly curved forward at the site of the fracture. A discharging sinus was dissected out and iodoform gauze introduced. The wound was closed with silkworm-gut sutures, and the leg put

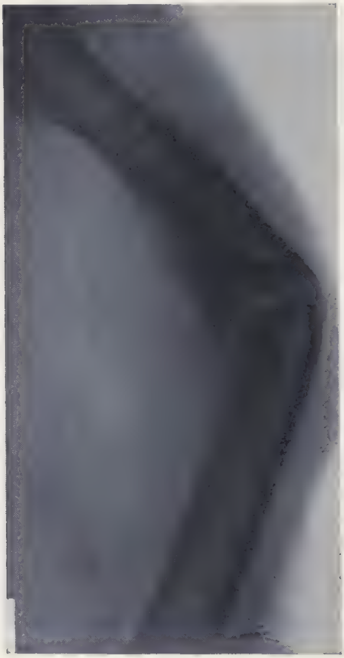

Fig. 150.

up in splints. The wound was completely healed on October 8th, when the boy was allowed to begin walking.

On December 1, 1915 it was evident that the femur was bent, and an *x*-ray examination made at this time showed that the bone was bowing considerably and that bony union had not been secured (Fig. 150).

This case, one of a very large number that have come under the care of the writer, proves conclusively that internal metal agents of all kinds cannot be trusted to hold fractured bone fragments in alinement. If lateral stress constantly comes upon the long Lane plate or the intermedullary ivory or metal cylinder, the bone at the point of pressure around the screw holes or at the end of the splint will melt away and the fixation will thus be lost, as shown in Fig. 150. There may be a difference of opinion as to why this fracture did not unite, but there is no question that the following etiologic factors had something to do with it: (1) the large amount of metal used and the consequent amount of bone destroyed due to inhibition of callous formation; (2) the interference with the end thrust of the fractured fragments during the most active osteogenetic period.

There may be a discussion as to the *modus operandi* of the Lane plate as an etiologic factor in producing non-union, but it will still remain true that in the writer's experience the metal plate comes first as the cause of this crippling condition. Apropos of this, it is believed that the very perfection of the fracture table—such as the Albee or Hawley tables—may, when improperly used, contribute to the etiology of non-union, in that the screws of the Lane plates are inserted while the fragments are held with a gap between their fractured ends. In this way the fractured ends are thus prevented from coming together until the destructive action of the metal screws, pushing against the bone, has destroyed it to a degree that the plate is loosened and the bone ends do not come together until the active osteogenetic period has passed.

Again, in this particular case, another fundamental principle was violated by removing the two fragments from the site of the fracture.

These fragments were attached to the muscle, and if left in place would undoubtedly have aided in furnishing callous formation. One cannot say whether or not they would have furnished sufficient osteogenesis to have turned the tide toward union. It is clear, however, that it was a mistake to remove them.

On February 20, 1916 an autoplastic sliding bone-grafting operation was done. For some reason the house surgeon had what seemed to be a religious scruple against the use of plaster of Paris. At no time since the treatment had begun on this leg had plaster of Paris been employed, and none was used at this time. A record in the notes made by the house surgeon states that on the second or third day, while the patient's leg was out of the removable splint for dressing, his activity in moving himself undoubtedly twisted the fragments in relation to each other and broke the sutures holding the graft in place.

One cannot condemn too strongly the fact that the surgeon entrusted a most important part of the surgical procedure to the house surgeon, namely, the application of the postoperative fixation. Only one individual should do this work—the operating surgeon himself. This part of the work taxes the full experience of the bone surgeon. It involves not only a carefully molded and applied plaster of Paris, but the question of the "posture of neutral muscle pull." This must be determined by careful study in each individual case. Furthermore, the attitude of the house surgeon in relation to plaster of Paris was entirely wrong. The writer has seen many cases in which it was certain that the failure from an operation of this nature was due to inadequate postoperative fixation. In one prominent case the sole postoperative fixation was the adjustment of the limb in a Balkan frame. The postoperative fixation cannot be too perfect. Absorbable sutures should always be used in the skin, and no windows should be made in the plaster for the purpose of their removal. It is not the window in the cast nor the removal of the suture that does the harm, however; it is the loosening of the splint by the removal of the dressing and the cotton packing overlying the wound.

On March 25, 1916 an *x*-ray examination showed no evidence of bony union. A considerable bowing of the leg began to occur.

On April 12, 1916 the bone-grafts were removed and drainage was instituted.

On May 2d the patient was first seen by the writer in a western city. At this time the bone ends were displaced and overriding about 2½ inches. The leg was severely infected and the wound was discharging a large amount of seropurulent material. The soft parts were separated from the ends of the fragments for a distance of about 2 inches, and the ends of bone were lying in a pool of pus.

Despite the state of infection, it was decided that in order to prevent permanent shortening and also to make conditions more favorable for overcoming the infection it was necessary to immediately enlarge the opening, place the bones end to end, and hold them in position with phosphor-bronze wire. This agent was chosen because it was feared that in the presence of an infection the kangaroo tendon would become absorbed too early. The ends of the bones were morticed in a V-shaped fashion with Albee's motor saw, so that there would not be a tendency for them to become displaced if necrosis took place and the wire cut through the bone.

This is a very important point in the technic of such a procedure, and it cannot be too strongly emphasized, namely, the morticing of the bone ends in such a way that the bone morticing takes the stress, and one does not need to trust entirely to the treacherous hold of any internal fixation agent, whether the Lane plate, metallic wire, or kangaroo tendon.

The wound was packed with iodoform gauze down to the junction of the two ends, and a long plaster-of-Paris spica with a large fenestrum over the wound was applied, reaching from the base of the toes to the costal margin, the leg being in about 20 degrees of flexion and the limits of physiologic abduction. After some weeks the phosphor-bronze wire came out. The wound drained for a long period, and finally healed in November, 1916. The femur remained ununited, and on September 21, 1917, at the New York Post-Graduate Hospital, the writer did an inlay graft operation from the tibia (for the technic of which the reader is referred to Albee's Orthopedic and Reconstruction Surgery, page 572). Skiagrams taken October, 1920, demonstrate very splendid results obtained (Fig. 151). The graft has become thoroughly amalgamated and the femoral shaft is fully restored except for about 1½ inch shortening. The function is excellent and considering the very difficult nature of the case it is very gratifying.

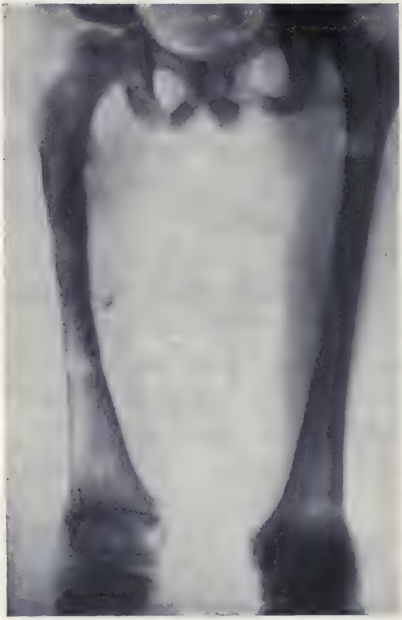

Fig. 151.—A very excellent result in a difficult pseudarthrosis of the right femur is shown. The graft has become so well amalgamated that it is difficult to determine where it was inserted.

Case II.—A. M., a prominent actress and dancer, twenty-seven years of age, fell on February 2, 1919, and sustained a fracture of the central portion of the neck of the right femur. On February 3d she was taken to the French Hospital and the fracture was reduced under an anesthetic and a long plaster-of-Paris spica was applied from the base of the toes to the costal margin, with the limb in marked abduction. The patient remained in bed until the plaster-of-Paris spica was removed on April 6, 1919. After that she walked with the aid of crutches, bearing weight on the fractured limb until the early part of May, 1919. Then she used one crutch until the last part of May. She received massage of the thigh and hip from the last part of May until the last part of July, and was advised to use the limb all she could.

On September 22, 1919 she consulted the writer, and at that time complained that weight bearing of all degrees was painful, that the limb felt weak, and that it was never comfortable to walk. In fact, she complained of pain all the time, night and day, exaggerated by standing or walking. When lying down the hip seemed to drop backward.

On examination patient walked with a limp of pain and weakness. When placed on the examining table in the dorsal position and the right thigh and knee flexed, a loose non-union at the hip was demonstrated by the examinner in this way. His left hand was placed on the patient's hip with the thumb on the anterior superior spine of the ilium, while the tips of the fingers were placed upon the great trochanter, traction upon the femur demonstrates a very free false point of motion at the hip, which was associated with pain. With the limbs fully extended the distance between the right anterior superior spine of the ilium and the right internal malleolus was 32¾ inches; while on the left side it was 33¼, demonstrating ½-inch shortening. When the right foot was forcibly pulled upon, the same measurements showed a shortening of only ¼ inch; and when the right foot was forcibly pushed upon the shortening was increased to ¾ inch. This test demonstrated conclusively that there was no union at the point of fracture, and force applied first by pulling and then by pushing brought about a difference of ½ inch in the length of the limb.

The motions at the hip were considerably limited in all directions by much spasm and were associated with pain.

An *x*-ray taken at this time showed an ununited fracture of the neck of the right femur (Fig. 152).

The Wassermann test was negative.

The writer's bone-graft peg operation was recommended, but the patient did not decide to have the operation until two months later.

Operation, December 2, 1919, ether.

Bone-peg graft operation. Patient in dorsal position on Albee fracture-orthopedic table. Feet covered by several thicknesses of plaster cotton and bound firmly into traction footpieces. Extensive fields of operation in regions of right hip and right lower leg were prepared by a generous coating of 3.5 per cent. tincture of iodin. The point of fracture was reached by an incision 5 inches in length, along the outer border of the sartorius muscle, reaching from the anterior superior spine of the ilium downward. The anterior portion of the capsule of the hip was reached by blunt dissection between the muscles. The hip-joint was entered by a T-shaped incision (Fig. 153, *a*, *b*). Fragments of the neck of the femur were found loose, with no attempt at union whatever. The fractured ends were covered with connective tissue and a reduplication of synovial membrane. The end of a pair of blunt scissors was readily placed between the

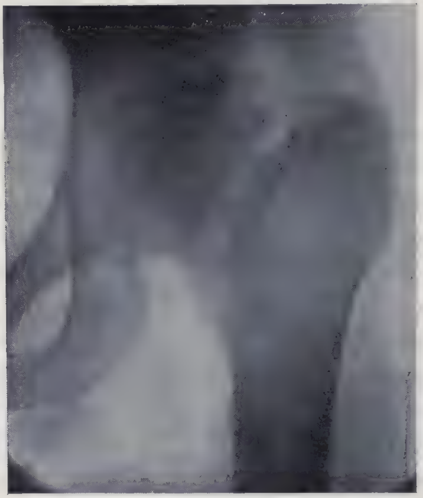

Fig. 152.

fragments, and by pushing with the end of the scissors on the fractured surface of the head fragment with some force it rotated freely. It was accordingly decided to insert a tibial bone-graft peg. If a failure to get the head to rotate had occurred the removal of the head with its placement of the trochanter in the acetabulum would have been done.

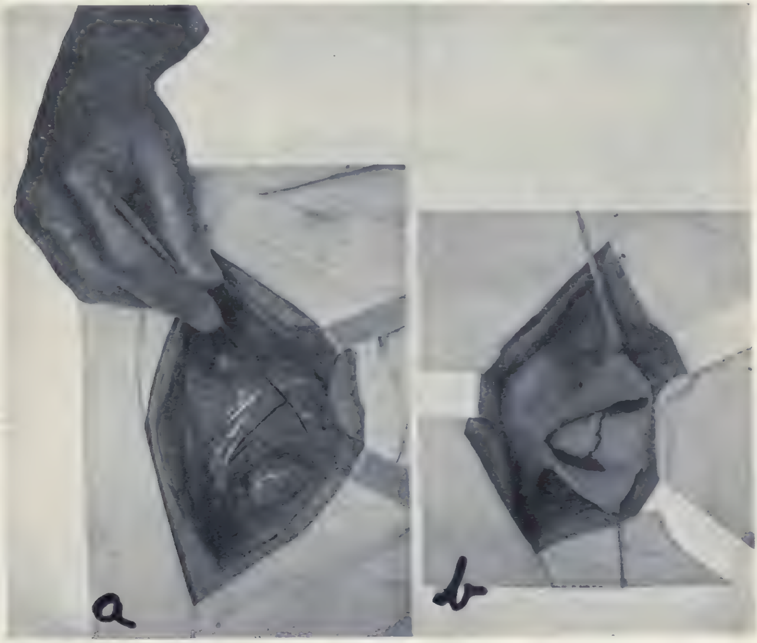

Fig. 153.

The table was so adjusted that the distal fragment of the femur was rotated slightly outward, laying bare its fractured surface so that it could be thoroughly denuded and freshened by means of osteotome and mallet (Fig. 154). The fractured surface of the head fragment was denuded in the same way.

This feature of the operation is important and should be done thoroughly, for the reason that dense connective tissue and sometimes portions of the joint capsule may be found lying in between the fractured fragments.

The next step was to determine the proper alinement of the fragments. This was accomplished by rotating the limb back with the foot directed upward and applying sufficient traction by means of the traction screw to pull the distal fragment down in alinement with the capsule fragment. The limb was then placed in about 30 degrees of abduction.

It has been found unwise to place the limb in too much abduction in old cases of non-union, because when removing the cast the weight of the limb brings in lateral stress upon the graft and there is danger of fracture, unless the cast is kept on for a very long period of time.

By means of the above-mentioned adjustments with the fracture table the fragments were brought into excellent apposition. In cases of a considerable amount of shortening it is not always wise to attempt to pull the distal fragment down so that the fragments will come into perfect end-to-end approximation, because of too much postoperative strain upon the graft. In this particular instance, however, the hip was so loose that there was no difficulty in this respect.

Fig. 154.

The wound was then temporarily packed with a hot saline compress, and the great trochanter was reached by a lateral incision directly over it, about 4 inches in length. The insertion of the vastus externus fascia at the outer surface of the great trochanter (Fig. 155, *b*) was developed, and an incision parallel with the shaft of the femur was made from this insertion downward for 1 inch, splitting the fibers of both the fascia and the underlying vastus externus muscle. Through this cut the point of the Albee hip drill was placed upon the outer surface of the trochanter about $\frac{1}{2}$ inch down from the border of this fascial insertion (Fig. 155). The electric power was then turned on, and the drill allowed to enter the bone for from $\frac{1}{3}$ to $\frac{1}{2}$ inch. The packing of the anterior wound was then removed and the proper direction of the drill was carefully estimated by means of bearings taken from the bony anatomy, observed through both wounds.

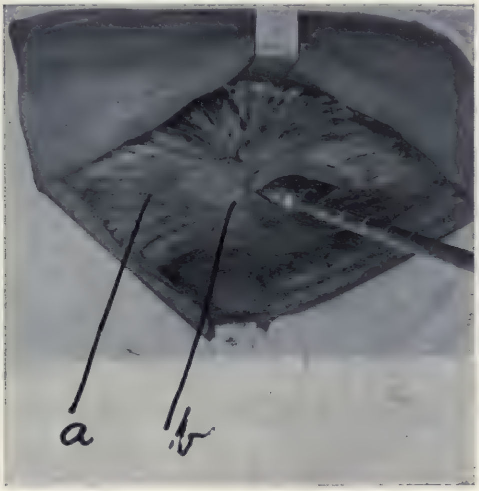

Fig. 155.

Roughly speaking, the drill should have a direction of 130 degrees with the long axis of the femur and 12 degrees posteriorly to the lateral axis of the knee-joint.

The drill was then allowed to travel through the distal fragment until it came in contact with a small ribbon retractor which had been placed through the anterior wound and between the fractured fragments. The distance the drill had traveled was then obtained by reading the centimeter markings on the shaft of the drill at the edge of the hole of entrance in the trochanter (Fig. 156, *a*).

A study of a recent anteroposterior x-ray plate was then made from an illuminating box standing in direct view during the course of the operation. The reading of the drill was 5 cm., showing that this was the distance from the outer surface of the trochanter to the fractured surface of the distal fragment of the hip-joint. Further studies of the x-ray plate showed that the distance that the drill should penetrate the capital fragment should be half of this distance, or 2.5 cm. The ribbon retractor was then removed, and the drill was allowed to travel into the capital fragment until the reading on the drill shaft at the edge of the trochanter drill hole was 7.5 cm. This brought the drill point within about ½ cm. of the hyaline cartilage on the head of the femur. The motor was then disengaged from the drill, which was left *in situ* in the drill hole for the purpose of preventing dislodgment of the bone fragments while the dowel was being shaped. Both wounds were loosely packed with saline compresses.

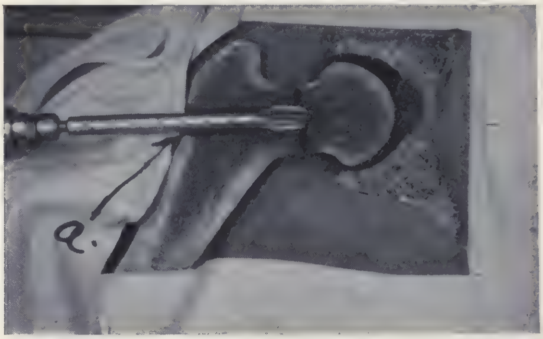

Fig. 156.

The field of operation was then changed to the leg. The crest of the tibia was palpated and it was determined that the crest was straightest at about the junction of the middle and the upper thirds. This portion of the crest of the tibia was then laid bare by means of a curved skin incision in the skin and blunt dissection of muscle and soft parts. The proposed graft was then outlined with the point of a scalpel on the periosteum. This should be done with care so as to obtain a graft of such a size that it will be necessary for the dowel shaper to remove only a minimum amount of bone in order to get a perfect dowel. In order to accomplish this the saw cuts must be made in the planes shown in this diagram (Fig. 157).

The graft was then cut 7.5 cm. long, with the Albee cross-cut motor saw, and was dislodged from the tibia with gentle taps of the osteotome and mallet. The lower end of the tibial graft was chosen for the inner end because of its thicker cortex. The upper end of the graft was then grasped by two heavy Ochsner clamps brought to a conical shape by inserting it in the Albee dowel "pencil sharpener" cutter, held on a small instrument table by an assistant, after which it was passed through the dowel-cutter itself, salt solution being dripped on both graft and cutter during this procedure. The drill was then removed from the neck of the femur and the bone-graft dowel was driven into place with gentle taps from a small mallet, the procedure being completed with the aid of the Albee bone-set, in precisely the same way that the cabinet maker drives home a nail in joiner work (Fig. 158).

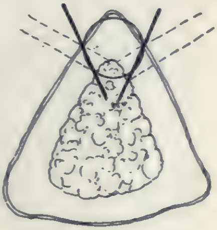

Fig. 157.

Several fragments of bone from ¼ to ⅓ inch long—consisting of the full thickness of bone cortex with marrow substance on one side and periosteum on the other—were obtained from the side of the upper end of the gutter wall in the tibia. This portion of the tibia was chosen because of the thinness of the cortex. These fragments were placed around the dowel graft and between the fractured ends of the femoral fragments (Fig. 159, *c*).

This diagram represents the writer's bone-graft peg in place in the femoral neck fragments. The fit is as accurate as power-driven automatic tools can bring about. The snugness of fit should be as near that of a glass stopper in a bottle as possible. The graft should not be driven in under compression, as this would cause an occlusion of the blood-vessels in the cancellous bone surrounding the graft and thus interfere with the very vital nourishment of the graft; *a* represents the ideal cross-section of

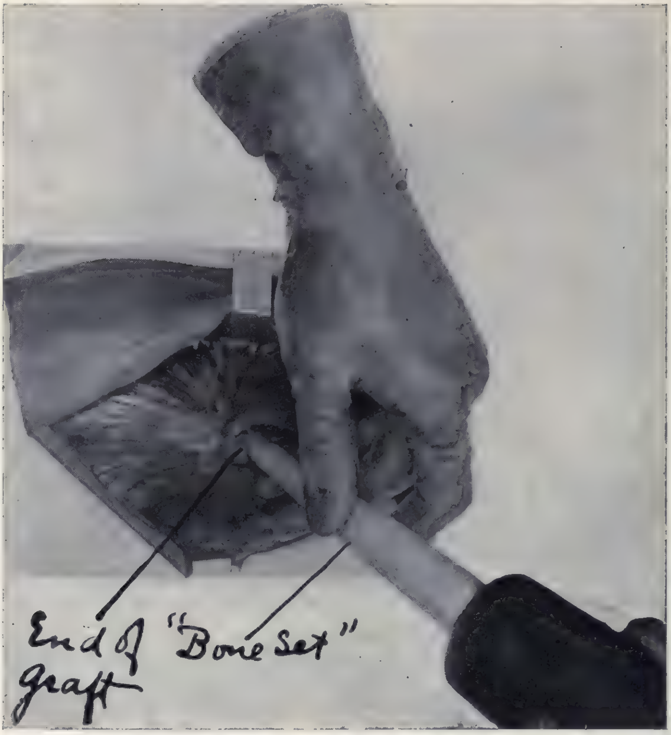

Fig. 158.

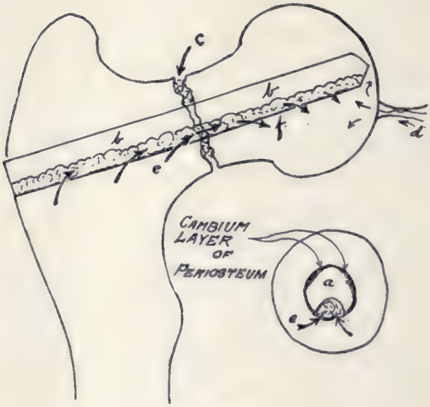

Fig. 159.

a graft in the neck of the femur. The arrow *e* indicates the direction of establishment of blood-vessels from surrounding cancellous bone to marrow substance of the graft. Arrow *d* indicates direction of blood-supply to head fragment from ligamentum teres, of direction of blood coming by way of marrow substance of graft from cancellous bone of trochanter to point of union between graft and head fragment.

Artificial impaction of both these fragments and the femoral fragments was then brought about by placing the end of the handle of a large wooden mallet against the outer surface of the great trochanter, just below the end of the dowel and striking the head of the mallet with the palmar surface of the hand.

The hip-joint capsule was then approximated with three interrupted sutures of fine kangaroo tendon. The wound was closed with chromic catgut No. 1 in the fascia, and plain catgut in the skin. The skin suture holes were puddled with 3.5 per cent. tincture of iodin, the excess fluid being wiped away. The skin wounds were covered with a large dressing of gauze and sterile absorbent cotton. The limb was covered with plaster cotton, and a plaster-of-Paris spica, well molded over the bony prominences, was applied from the base of the toes to just below the costal margin on the right and above the costal margin on the left.

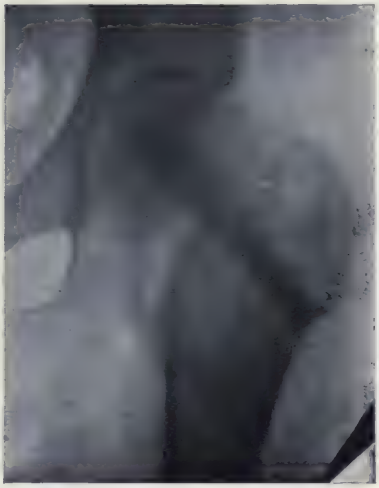

Fig. 160.

The plaster was allowed to remain on for eight weeks. A skiagram (Fig. 160) was taken immediately after the removal of the cast. Although everything seemed to be entirely satisfactory, it was deemed wise not to run any risk of breaking the graft, and a small brace made of light metal and leather was applied over the pelvis and extending down to just above the knee-joint. The patient was then allowed to go about with crutches, without bearing any weight upon the operated limb. Other x-ray plates were taken at periods of one month which showed very satisfactory proliferation of graft and consolidation with strong union (Fig. 161). Four months after the operation the patient was allowed to begin bearing weight upon the leg. Massage to hip and knee was instituted as soon as the plaster cast was removed. The convalescence of the patient has been most gratifying, and eight months after the operation she states that she can walk and dance as well as ever.

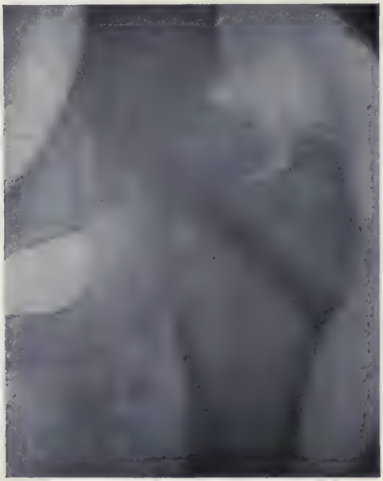

Fig. 161.

This case is only one of many in which similar results have been obtained, and it is a striking demonstration of the fact that these conditions respond gratifyingly to proper treatment, despite the oft-repeated statements to these unfortunates that their condition is hopeless.

Case III.—L. C. G., sixty years of age, came under observation December 16, 1916 with a history of having fallen from the third step of the cellar stairs backward on to the cemented cellar floor, striking on the left hip, and was unable to stand immediately following the fall. The patient was anesthetized and the fracture was reduced within half an hour, and the limb was immobilized with wooden splints. Forty-eight hours later the patient was taken to the hospital in an ambulance, and *x*-ray plates were taken, and the patient was told she had a fracture of the hip. The wooden splints were removed and sand-bags were placed on either side of the limb from the axilla to the foot and from the groin to the toes, this being continued for a period of five weeks. At the end of this time another *x*-ray was taken and the patient was told that the appearance of the plate indicated that perfect union had taken place. She was then encouraged to walk and bear as much weight on the limb as she could. This produced pain, which was described by the patient as great agony. In June, 1916 a short celluloid spica was applied for a period of three months. During this period she walked with crutches and an elevated shoe on the normal side. Following this crutches were used and only a small amount of weight was borne on the fractured limb.

Fig. 162.

An *x*-ray examination made on December 19, 1916 showed non-union of an intracapsular fracture of the neck of the femur, with almost complete loss of the neck from erosion (Fig. 162).

Operation, December 21, 1916.—Because of the extreme amount of loss of bone at the neck and the added *x*-ray observation that the femoral head was a mere shell, it was decided to remove the head and to place the neck and denuded trochanter in the acetabulum, a procedure devised by the writer and previously employed most successfully. The hip-joint was reached by the Sprengel or Smith-Pedersen approach. In fact, it is the practice of the writer to use this approach for all operations on the hip-joint. The anterior incision is used only when inserting the bone-peg graft for fracture of the neck of the femur. An incision was made along the iliac crest from the anterior superior spine posteriorly for about 4½ inches. This incision was then carried downward from the anterior superior spine of the ilium for about 4 inches. The fascia lata was then severed about ½ inch below and parallel with the crest of the ilium. Subperiosteally the gluteus medius, minimus, and tensor vagina femoris were separated and carried downward at the same time that the hip-joint was approached through the muscle planes by blunt dissection by way of the anterior incision. The anterior and superior portion of the hip-joint capsule was developed, and a T-shaped incision was made exposing the femoral head and the neck.

The *x*-ray findings were confirmed. The head was a mere shell and the neck was much shortened. The head was removed. The corner of the end of the neck was then trimmed away and the trochanter was incised with the osteotome, as shown on the diagram (Fig. 163, *C*). The limb was then pulled down with the traction screw on the fracture table until it was possible to push the neck and molded upper portion of the trochanter into the acetabulum. The table was then adjusted so that the limb was in an extreme degree of abduction. This posture not only held the trochanter bone lever in the desirable degree of obliquity with the shaft of the femur (Fig. 164, *E*), but held the neck and molded trochanter in the acetabulum with great firmness. The trochanter bone lever was then held forward by interrupted sutures of medium kangaroo tendon. The fascia was closed with continuous sutures of No. 1 chromic catgut; the skin, with No. 1 plain catgut. A plaster-of-Paris spica was then applied from the base of the toes to just below the costal margin on the left, and 2 inches above the costal margin on the right side. This

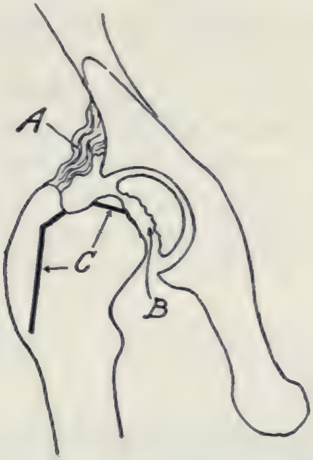

Fig. 163.—The upper end of the trochanter fragment formed by the outer portion of the bone incision (*C*) is forced outward by a strong instrument, producing a greenstick fracture as shown in Fig. 164, 1, at *C*.

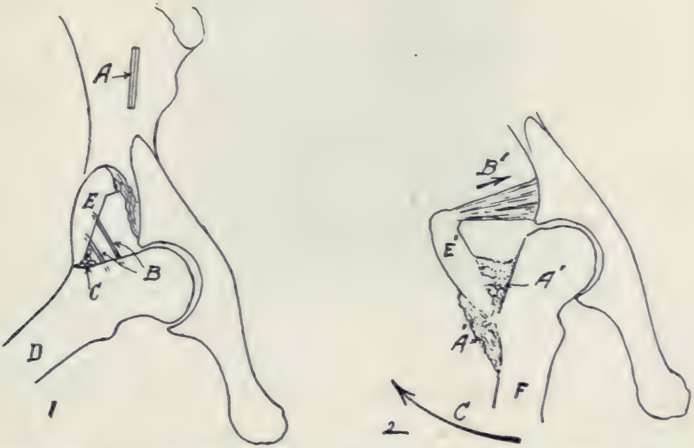

Fig. 164.—1. *D* represents femur abducted; *E*, trochanter lever held in its present position by abduction of the femur; *B* are sliver grafts obtained from the side of the ilium at *A* for the purpose of hastening callus formation at *A*. 2. *F* represents femur brought down in position of right angle to pelvis. The direction of the trochanter lever arm *E'* is as shown since bony union at *A'* has taken place. Under these conditions the muscles at *B'* act as abductors of the thigh, at the same time that they and the surrounding soft parts prevent dislocation of the trochanter from the acetabulum in that they become tense at *B'* as the limb is swung into adduction, the only posture in which a dislocation of the trochanter from the acetabulum is likely to occur.

cast was kept on for a period of seven weeks, after which the patient was allowed to walk with crutches and bear weight. In two months the patient was using a cane and bearing full weight on the limb. In ten weeks full weight bearing caused no pain, and motion in flexion and extension was within 10 per cent. of normal; abduction, within 20 per cent. of normal. All pain had ceased, and the patient stated that when walking and bearing full weight upon the limb the hip again had a feeling of firmness and stability.

Figure 165 is a skiagram made six months after the operation. It shows the end of the neck well within the acetabulum and the trochanter lever firmly united in the oblique position to the shaft of the femur.

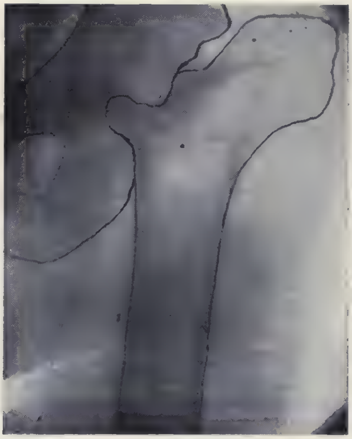

Fig. 165.

Case IV.—Tuberculous Osteitis of the Hip.—Miss M. L., age forty-three, consulted me in May, 1910, presenting every symptom and sign of tubercular hip disease on the right side. The stiffness and pain had come on gradually, beginning in 1908, the pain radiating from the hip down the thigh to the knee. The patient had lost 20 pounds in weight, and was rather pale. She had been treated for rheumatism of the knee.

On physical examination, the patient walked with a right-sided limp of pain and stiffness. There was no actual shortening. When measurements were taken from the umbilicus to the internal malleoli there was $\frac{1}{2}$ inch of practical shortening. The circumference of the right calf was $\frac{1}{2}$ inch less than that of the left; the circumference of the right thigh was $\frac{3}{4}$ inch less than that of the left. All motions of the hip were much limited by muscle spasms, and all attempts at passive motion elicited severe spasms and pain. The limb was somewhat adducted and rotated outward.

An *x*-ray examination demonstrated much rarefaction of the head of the femur and some destruction of the acetabulum just under the cartilage; in other words, it confirmed the clinical diagnosis of tuberculosis.

Treatment.—A Phelps hip brace with a 2-inch cork extension on the left shoe and crutches were prescribed, also a régime of life suitable for a tuberculous patient, namely, general rest, fresh air, and forced feeding.

For two years the patient wore the brace, with crutches, and religiously observed the treatment advised. The results, however, were so far from satisfactory that it was decided to surgically immobilize the diseased hip. In view of the fact that a tuberculous lesion existed in the hip-joint it was not thought wise, if it could be avoided, to enter this infected region, and it was therefore decided to bring about a bony ankylosis by means of a truss work of two bone-grafts extending from the great trochanter to the side of the ilium, 2 inches above the hip-joint, as shown in diagram (Fig. 166).

Operation.—A curved incision about 6 inches in length, with its convexity forward, was made with its lower end over the trochanter extending upward over the gluteal muscles. The outer surfaces of these muscles were laid bare and two incisions were made in them in the shape of a V, converging at the trochanter, with the upper ends about 3 inches apart at the ilium. With the Albee motor saw two cuts in the form of a V with its apex downward were made for a depth of about $\frac{1}{2}$ inch in the outer surface of the trochanter. Trap-door flaps, consisting of a portion of the trochanter and the overlying sound parts, were then turned upward and downward, leaving between them the V-shaped island of the trochanter intact and undisturbed. The outward surface of the wing of the ilium at the upper ends of the cuts in the gluteal muscles was then laid bare by blunt dissection. Mortices $\frac{1}{2}$ inch in width were then made through the outer table of the ilium by means of a long osteotome, which was placed during this procedure with its cutting surface against the

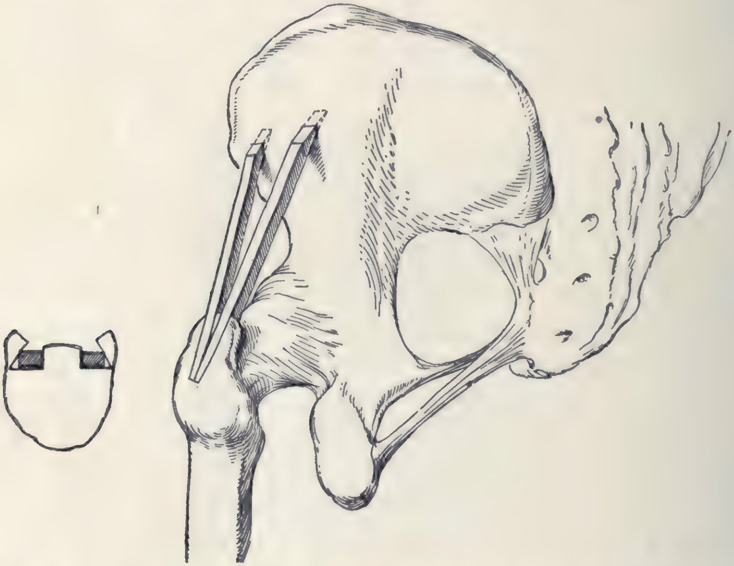

Fig. 166.—Method employed by the writer since 1912 for extra-articular fixation and support of the hip-joint affected by tuberculosis or other destructive lesion. Two tibial bone-grafts are used: one end of each is inlaid in the great trochanter, the other end is made wedge shaped and driven into mortise made in the wing of the ilium. (From Albee, "Orthopedic and Reconstructive Surgery.")

outer surface of the ilium and its outer end in the groove made by turning up the trap-door from the trochanter.

With the aid of the Albee "bone set" placed against the head of the osteotome and blows of a mallet the cutting edge of the osteotome was driven through the outer table of the ilium, producing two mortices in the outer table of the ilium and extending into the cancellous bone beneath; these were situated 3 inches apart and 2 inches above the hip-joint. The length of the desired grafts was then determined by the aid of two flexible probes.

The wound was then packed with a large hot saline compress, and the anterior internal surface of the tibia was exposed by a curved incision over the crest of the tibia extending from just below the tubercle of the tibia to about 3 inches above the ankle-joint. Grafts of the desired length and about ½ inch wide were then mapped out in the central portion of the anterior internal surface of the tibia, one above the other. With the Albee twin saw adjusted at a distance of ½ inch apart parallel cuts were made in the center of the antero-internal surface of the tibia. The upper ends of the graft were then beveled on the periosteal side (Fig. 166) while severing them with the Albee cross-cut motor saw. These grafts were then dislodged by means of the osteotome and mallet, retaining all the marrow substance that clung to them. The grafts were then placed in the beds prepared for them at the hip; the beveled ends of the grafts were placed in the mortises in the sides of the ilium, with the beveled surfaces outward, and other ends being placed in the grooves in the trochanter. By means of the "bone set" placed against their trochanter ends and blows of a mallet the grafts were then driven for a distance of about ½ to ⅔ inch into the mortises already prepared in the side of the ilium. The purpose of beveling the upper ends of the graft on their outer side was to cause the lower end to press firmly into the trochanter gutters when the grafts were driven into place.

The trochanter trap-doors were then pulled over the lower ends of the grafts by means of interrupted sutures of fine kangaroo tendon placed in the peri-osseous soft parts. These were the only fixation ligatures necessary. The muscles were drawn together above the grafts by means of a continuous suture of chromic catgut No. 1, and the skin was closed by means of a continuous suture of No. 1 plain catgut. The tibia skin wound was treated likewise. The suture holes were puddled with 3½ per cent. tincture of iodin, and generous dressings of gauze and sterile absorbent cotton were applied.

The limb was then immobilized with a long well-molded plaster-of-Paris spica extending from just above the costal margin to the base of the toes.

The convalescence of this case was uneventful. The wounds healed by primary union, and the grafts grew in most satisfactorily (Fig. 167). The pain, which had not previously been relieved by the most careful bracing, ceased entirely. This patient was sent to the Burke Foundation at White Plains shortly after the operation in 1912 for proper environment and convalescence. She did remarkably well there, and was transferred from the patient list to the employees' list, and is still employed there at the present time.

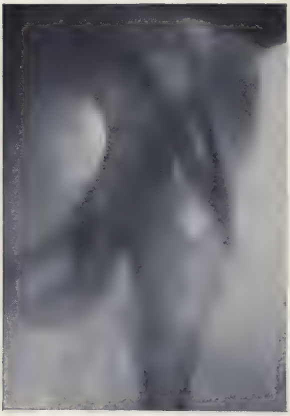

Fig. 167.—A skiagram taken eight weeks after insertion of grafts.

The *x*-ray study of the proliferation of these grafts is most interesting (Fig. 168). The immobilizing effect of the grafts brings the largest amount of stress upon them, at or near the fulcrum point at their lower ends, and this is where the greatest amount of proliferation and increased thickening of the grafts has taken place. Estimating from an *x*-ray study, the grafts have increased their diameters about eight to ten times at their trochanter ends, while they have proliferated only three to four at their cross-section at their iliac or upper ends.

Case V.—Rev. C. C. L., referred by Dr. Howard Kelly, of

Baltimore, was fifty-two years of age. At the age of nine he began to have pain in the right hip when walking. He could walk only about six blocks, after which the pain became so great that he had to stop. He has been handicapped all his life by this painful hip. During the past year the hip became much more painful and stiff, so that he has been able to take very little exercise and has become very heavy. He can scarcely walk two blocks now. In the past few months the pain and stiffness have become excessive. Has had a number of treatments by electricity and radiant light. He has had no sore throats or evidence of tonsillar infection, and the *x*-ray plates of the teeth are negative for focal infection. The Wassermann reaction also is negative.

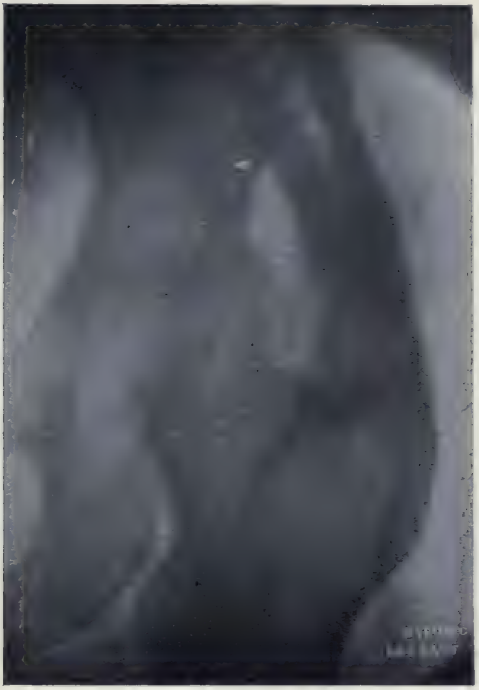

Fig. 168.—A skiagram of the same case as Fig. 167 taken eight years after the insertion of the grafts. The remarkable increase in density and diameters of the grafts, especially at their lower ends where leverage stress occurs, is striking.

Excepting for the condition of the hip, his health has always been excellent.

Examination: Abnormally heavy, the patient walks with a marked limp of stiffness, shortness, and pain; and stands with the right extremity rotated outward, flexed, and adducted. With the patient on the examining table in the dorsal position the distance from the right anterior superior spine of the ilium to the internal malleolus was $33\frac{3}{4}$ inches; on the left, the same measurement was 34 inches. From the umbilicus to the right internal malleolus the measurement was 36 inches; the same measurement on the left side was $37\frac{1}{4}$ inches. This disclosed an actual shortening of $\frac{1}{4}$ inch and a practical shortening of 1 inch due to the adduction flexion deformity. There was a marked atrophy of the muscles of the thigh and leg. The right leg was markedly rotated outward, adducted, and flexed to 120 degrees, with about 10 degrees of motion. Rotation, abduction, and adduction were practically nil at the hip. All attempts at passive motion elicited severe pain.

The *x*-ray examination by Dr. B. C. Darling revealed a very advanced osteo-arthritis of the right hip-joint (Fig. 169). In view of the deformity and the severe pain from locomotion and all movements of the hip, it was decided to do an operation to bring about ankylosis of the hip-joint. This treatment of osteo-arthritis of the hip-joint was first reported by the writer at the International Medical Congress at Budapesth, Hungaria, in 1909. Since that time 120 such cases have been operated upon by me with excellent results.

Three years ago, after reading the report by a colleague of favorable results obtained in such cases by arthroplasty, I was stimulated to try to maintain motion and still do away with pain by chiseling off a large portion of the overgrown head and molding it into a spheric shape. The acetabulum was left undisturbed. Four cases were selected for this treatment. They were all operated upon over a year ago, and have all proved unsatisfactory, in that the patients still have pain and discomfort and are not satisfied with the results of the treatment. In view of this experience, I am naturally more than ever convinced that in this particular monarticular condition fixation should be the aim of the treatment. Bracing or plaster-of-Paris splints are especially unsatisfactory in these cases, in that after the brace or splint is worn for many years the painful condition still remains, undoubtedly largely because it is a degenerative and not a bacterial process. Patients with this condition are apt to be obese because of the absolute interference with all forms of exercise, and this again adds to the difficulties of immobilization by any external means. This was especially the case in this instance.

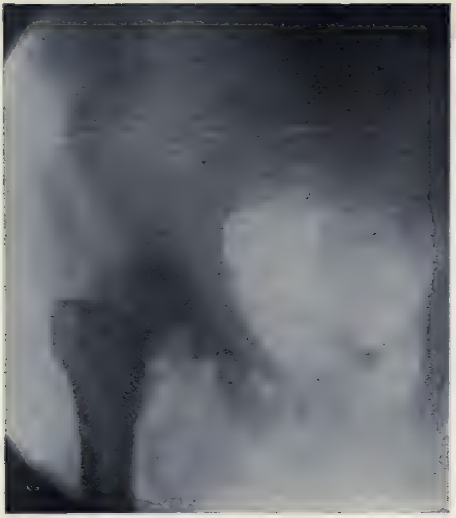

Fig. 169.

Attention may here be called to the age of this patient, fifty-two years, and the fact that he has been suffering from this condition practically all his life. Osteo-arthritis of the hip has been called senile coxitis, but it is not essentially a condition of the aged, for it may occur at all periods of life. In this instance it began at nine years of age, and I have seen many others begin at an age not much over this. It has been classified from the clinical *x*-ray standpoint as a hypertrophic type of arthritis deformans; from the pathologic standpoint it has been classified as the degenerative type of arthritis deformans.

Operation.—With the patient in the dorsal position on the Albee fracture-orthopedic table, the feet were covered generously with plaster cotton and bound to the traction foot-pieces with 4-inch muslin bandages. The hip-joint was reached by the Sprengel or Smith-Pedersen approach. The skin incision was made along the crest of the ilium from a distance of 5 inches posterior to the anterior superior spine forward to the anterior superior spine itself, and then straight down for a distance of 4 inches. The fascia lata was cut parallel with the crest of the ilium and about ½ inch below it, thus furnishing a means of suturing the fascia lata to the crest of the ilium later on when closing the wound. The gluteus medius, minimus, and tensor vagina femoris muscles were then separated subperiosteally from the side of the ilium by means of a broad osteotome, and carried downward to the superior surface of the hip-joint. This triangular skin and muscular flap was then completed by blunt dissection down from the anterior superior spine and just outside of the sartorius muscle. This gives the best exposure of the hip-joint.

The joint capsule was then laid open by a T-shaped incision, the top of the T being parallel to and just below the rim of the acetabulum. By attempting to rotate the femur in and out a close inspection of the joint confirmed the *x*-ray findings, namely, that there was an extensive rim of osteophytes extending from the rim of the acetabulum and also from the outher rim of the femoral head. The synovial membrane and hyaline cartilage were largely absent from the top of the femoral head, in fact, this portion of the head had the well-known worm-eaten appearance caused by the bone being actually worn away after the loss of the cartilage. The bone was also polished and glittered like marble.

With a broad chisel and mallet a large portion of the osteophytes on the rim of the acetabulum was removed; and with the same instruments about one-fifth of the top of the head of the femur was removed through a plane sloping inward and upward, and also with the same instruments the top of the acetabulum was transformed into a flat surface. While the femur was being rotated strongly inward and outward, all accessible cartilage was removed from the remaining portion of the femoral head. This allowed the freshened plane surfaces of the femoral head and the acetabulum to come nearer together, though not in close proximity.

The table was then so adjusted as to bring the foot straight up and the limb was abducted at the hip about 10 degrees and flexed about 10 degrees. The digital fossa on the inside of the trochanter was then deepened by means of a narrow osteotome and mallet, thus making a groove about $\frac{1}{3}$ inch wide and about $\frac{3}{4}$ inch deep in a plane parallel with the outer surface of the ilium just above the acetabulum.

With the point of a scapula a large graft was then outlined on the outer surface of the ilium, $3\frac{1}{2}$ inches long by 2 inches wide, its lower end including the superior rim of the acetabulum. With the Albee motor saw the graft was then cut through the outer cortical table of the ilium according to the pattern outlined. It was then removed from its bed with a broad thin osteotome.

If care is not exercised in this work the inner cortical table of the ilium will be damaged or a portion of it removed.

The large rectangular graft thus obtained was turned end to end, and what was the upper end was thrust firmly into the groove in the upper end of the femur, the other end placed in the lower end of the gutter formed by removing the graft as shown in diagram (Fig. 170). In a way, this is another application of the speaker's inlay graft which he has so frequently used in ununited fracture of the long bones.

The wound was then closed with a continuous suture of chromic catgut in the fascia, and a continuous suture of No. 1 plain catgut in the skin. The approximation of the affected muscles against the side of the ilium thus secured was very gratifying. It may be noted that this approach does very little damage to the muscles and other soft parts of the hip, and it constitutes almost an epoch-making event in the plastic surgery of the hip-joint. The speaker uses this approach for all plastic operations upon the hip-joint, reserving the anterior incision for approaches to the neck of the femur only.

The suture holes in the skin were then puddled with $3\frac{1}{2}$ per cent. tincture of iodin, extensive dressings of gauze and sterile absorbent cotton were placed over the incision, and a long plaster-of-Paris spica was applied from the base of the toes to 2 inches below the costal margin on the right side and 3 inches above the costal margin on the left. This splint was worn for a period of eight weeks, after which an *x*-ray plate was taken which indicated firm union of hip surfaces and graft (Fig. 171, *a*). The patient was allowed up and about on crutches, bearing some weight on the foot.

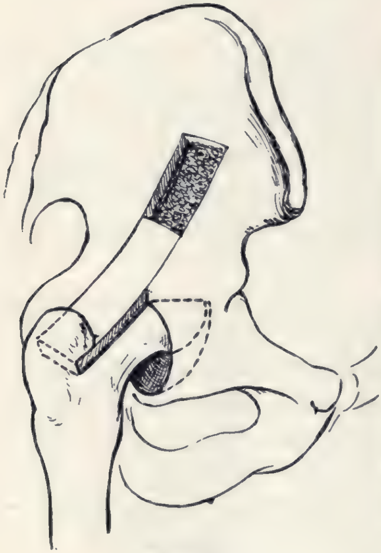

Fig. 170.

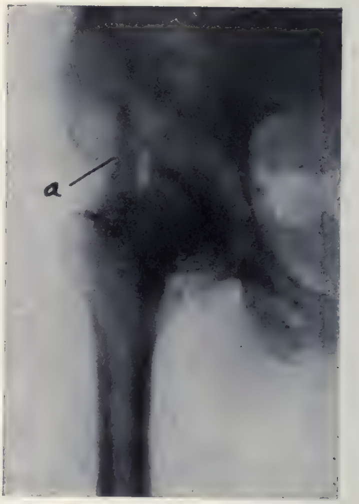

Fig. 171.

The subsequent convalescence of this patient has been most satisfactory, in that all pain has ceased, and he takes a rather paradoxic view of the result of the operation, in that he says he has more motion of the hip now than before the operation. This attitude of the patient has been noted in a number of other cases, and is accounted for by the fact that the absence of pain overcomes the muscle spasm at the lumbar spine, knee, etc., to such a degree that compensatory action of the surrounding joints is surprisingly restored. Although the operation destroys the motion of the particular joint, nevertheless, from the point of view of the patient, the results are brilliant.

CLINIC OF DR. LEO BUERGER

NEW YORK POLYCLINIC MEDICAL SCHOOL AND HOSPITAL

CLINICAL LECTURES ON SOME COMPLICATIONS OF URINARY LITHIASIS

BELIEVING that you will obtain a more vivid and concrete conception of the pathology, clinical course, and surgical therapy of certain of the complications of urinary lithiasis through a consideration of clinical material rather than by a didactic scientific exposition, I beg you to be indulgent enough to follow me through the lessons that can be drawn from these interesting and illuminating cases. We shall not attempt a comprehensive exposition of all of the possible complications of urinary stone, for volumes could be written upon this single subject alone. Let us rather confine ourselves to an analysis of a few striking and valuable examples.

And so, for our series of clinics, we shall begin with a discussion of:

First, Calculus in the ureter with symptoms simulating intestinal obstruction.

Second, Anuria and reflex suppression of urine.

Third, A. Perforations of the urinary tract:
- (*a*) Perforations of the kidney.
- (*b*) Perforations of the pelvis.
- (*c*) Perforations of the ureter.

B. Potential perforations:
- (*a*) Of the kidney.
- (*b*) Of the renal pelvis.
- (*c*) Of the ureter.

I. URETERAL CALCULUS WITH SYMPTOMS OF ILEUS

Calculus of the Ureter with Symptoms Simulating Intestinal Obstruction and Even Peritonitis.—We are not infrequently called to see patients at their homes in whom cursory examination might lead us to diagnosticate intestinal obstruction. Where a history of previous lumbar pain has not been obtained, and where the existence of costovertebral tenderness, or pain radiating from the lumbar region into the groin, iliac region or testicle, has not been elicited, particularly when blood in the urine is absent, it has not infrequently occurred that an exploratory laparotomy has been advised.

That such a procedure may be fatal when we are dealing with a case of impacted ureteral calculus producing symptoms of ileus I have had occasion to observe in a patient who was operated upon in one of our large hospitals. In this case the diagnosis of intestinal obstruction was made, and a laparotomy performed. Nothing was found but some doubtful adhesions, and the patient succumbed shortly thereafter with uremic symptoms due to suppression of urine, and the autopsy showed a calculus blocking the lower left ureter.

During the last five years I have been able to diagnosticate 7 such cases, all of which gave the symptoms of intestinal obstruction. Let us comment on the vagaries in the symptomatology of ureter stone in a discussion of the following case, the clinical course of which, briefly summarized, would read:

Case I.—Impacted, Obstructing Ureteral Calculus, Dilated Ureter and Renal Pelvis, with Manifestations Now of Intestinal Obstruction, Now of Peritonitis; with Fever, Abdominal Distention, Rebound Tenderness; Completely Relieved and Cured through Cystoscopic Methods that Caused Expulsion of the Stone.—L. S. B., male, presented the following clinical picture: A distended abdomen, constipation, severe pain in the left iliac fossa, rigidity of the left iliac region, distinct rebound tenderness, and per rectum a small indefinite mass, high up in a culdesac on the left side. Cystoscopy (October 4, 1919) demonstrated that there was urinary retention in the left ureter and kidney, for about 1 ounce of turbid urine, containing some red blood-cells, without pus, could be collected in a continuous stream when a catheter was inserted some 10 cm. into the ureter. These data suggested a calculus low down in the ureter, with a dilated ureter and acute hydronephrosis.

In spite of the relief that was afforded in this case through emptying the kidney, distinct aggravation of the symptoms occurred the next day, when the temperature rose to 102° F. in the afternoon. It was surmised that by virtue of the swelling of the ureter obstruction had again taken place, so that catheterization of the ureter was again in order. On the following day (October 5th) the tongue was coated, the left side of the abdomen was hard, with board-like rigidity, the temperature was 103° F., and the patient was unable to take food; in short, symptoms suggestive of intestinal obstruction and possibly peritonitis. On October 6th, therefore, catheterization of the left ureter was done again, and the same phenomena of retention of urine could be demonstrated. So great was the accumulation that pressure over the kidney and bladder region as well as over the left iliac fossa increased the flow through the ureteral catheter. Two ureteral catheters were then inserted into the left ureter up to the kidney, and the cystoscope removed, *the catheters being allowed to remain from the time of insertion* (3 P. M. on October 6th) *until the next morning* (9.30 A. M.). On October 7th the abdomen was distinctly less rigid, and the patient's condition considerably improved, the temperature having dropped to 100° F. The catheters were then slowly withdrawn simultaneously, and as they were pulled out it seemed that an obstruction to their exit could be distinctly made out. As their tips emerged this resistance was seen to be due to the extraction of a ureteral calculus that was tightly adherent to the two catheters. It had not been detached throughout its passage from the ureter into the bladder and urethra—a most remarkable and unusual occurrence. From then on the patient made an uneventful recovery.

II. ANURIA AND REFLEX SUPPRESSION OF URINE

Complete anuria over varying periods, days, and even lasting a week, is an alarming but not necessarily irremediable eventuality as a sequence of any of the following lesions of calculous disease:

First, Bilateral renal blockage.

Second, Bilateral ureteral blockage.

Third, Unilateral reno-ureteral blockage, with reflex functional suppression of the other kidney.

Fourth, Unilateral reno-ureteral blockage, with acute infection and urinary suppression of the other kidney.

Fifth, Bilateral renal infection with calculus.

Sixth, Unilateral blockage with anomaly, maldevelopment, aplasia, other pathologic lesion, or postoperative malfunction of the other kidney.

Seventh, Chronic nephritis with unilateral or bilateral blockage.

These are some of the more common conditions that you must have in mind when confronted with the problem of relieving surgical types of urinary suppression. Nor must a purely medical or so-called "nephritic" anuria be the diagnostic label for those patients who are said, by their family physicians, to have Bright's disease. For, even in some of these, complicating, undiscovered lithiasis may be the motivating factor in the sudden arrest of function.

In short, our patient with steadily diminishing urinary output, or with sudden cessation of the same, whether localizing symptoms be present or not, should be approached for diagnostic appraisal in this sense: Is the condition

1. Medical (nephritis) alone?
2. Medical with superinduced mechanical or infectious surgical complication?
3. Reno-ureteral blockage with or *without* localizing symptoms?

For, without careful analysis and urologic investigation, you may lose patients whom either a simple cystoscopic procedure, with or without correct surgical intervention, could possibly save.

Remember that anuria lasting for a number of days can frequently be abolished and the patient cured by decapsulation and nephrotomy. Not infrequently do we encounter examples of bilateral calculous disease in patients who make unreliable and unintelligent observations; or, we are consulted by physicians whose opportunities for the clinical study of their cases have been inadequate. And so it happens that we are told that the suppression of urine has set in without symptoms, and without suspicion of the existence of urinary lithiasis.

Where a patient has bilateral calculous disease, and the process advances for years without signs, anuria may unexpectedly supervene.

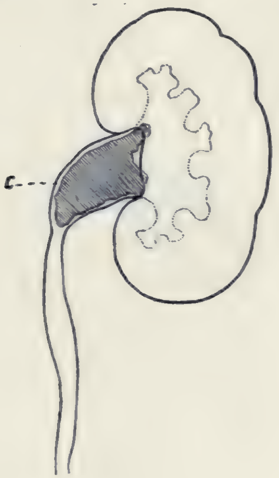

Fig. 172.

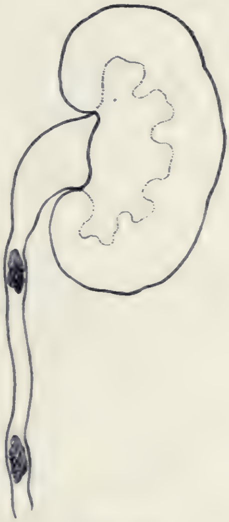

Fig. 173.

Fig. 172.—Diagrammatic representation of a large stone blocking the extrarenal pelvis, with moderate dilatation of the intrarenal pelvis.

Fig. 173.—Fairly marked dilatation of the pelvis with one or more stones in the ureter.

Then you must weigh the possibilities already outlined in a previous clinical talk. Consider whether the patient has been living on one kidney, with the other practically destroyed. Reflect on the assumption that infection or blockage of the remaining functionating organ may be responsible for the total disappearance of secretion. And do not exclude the more grave situation where the patient is in the terminal stages of functional imbalance with both kidneys markedly involved, the better kidney having become suddenly shut off or infected.

Since the visual memory so frequently is of value in awakening our powers of differential diagnosis, it may be well for you to glance at the pictures I now present to you, for these offer a few of the possibilities in reno-ureteral lithiasis that may be responsible for the sudden advent of anuria.

Thus in Fig. 172 a large stone occupies the greater portion of the extrarenal pelvis. Should infection suddenly occur, or were there an associated ureteral calculus in the other tract, anuria might ensue. In the same picture, on the right (Fig. 173), the favorite sites for the impaction of ureter stone are shown, namely, near the ureteropelvic junction in the upper lumbar region, and at a point about 4 or 5 cm. above the bladder. With this there is associated a moderate or marked dilatation of the ureter and pelvis of the kidney, and, if sudden incarceration occurs, reflex suppression of the other kidney may occur.

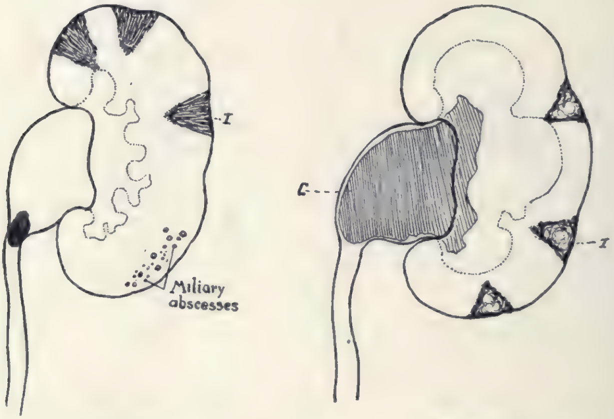

Fig. 174. Fig. 175.

Figs. 174, 175.—Diagrammatic representation of suppurative lesions associated with stone.

We must remember that with a stone impacted at the ureteropelvic junction (Fig. 174) suppurative invasion of the kidney, as seen in this illustration in the form of pyramidal infarct or miliary abscesses, may supervene at any time, possibly associated with reflex suppression of the function of the other kidney.

Or, with a large stone or multiple stones in the pelvis causing chronic blockage and hydronephrosis, suppurative and even gangrenous inflammation may occur (Fig. 175).

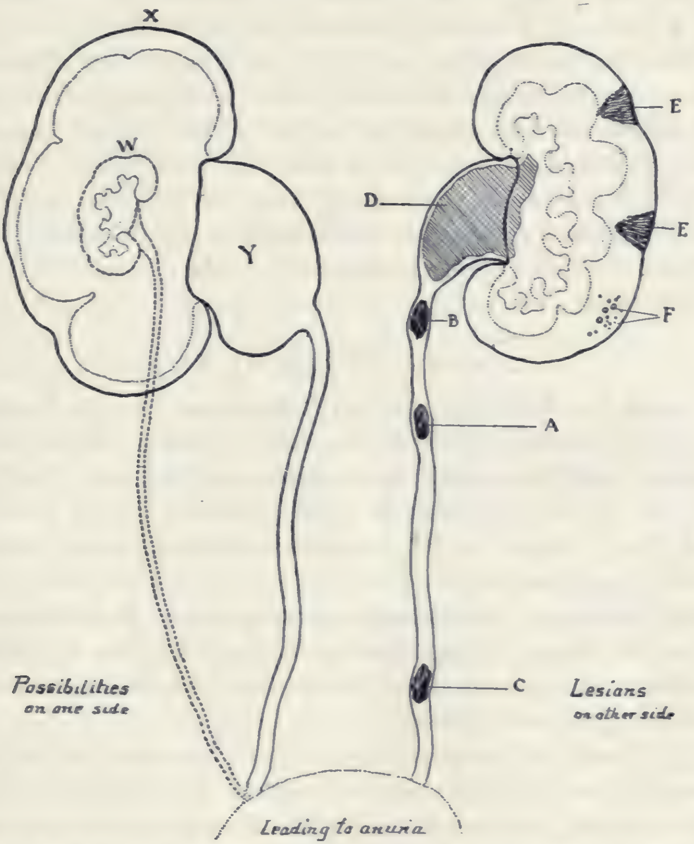

Fig. 176.—Schematic drawing showing some of the possibilities that may lead to anuria when stone complicated with infection is present on one side, with malformation or anomalies on the other side (*W*), or congenital hydronephrosis (*X*, *Y*), or other malformation.

Finally, any one of these or a combination of these lesions as seen in the right half of Fig. 176 may be associated with congenital or mechanical obstruction on the other side. In Fig. 176, on the left, *W* represents an atrophic hydronephrosis (congenital); *X*, *Y*, large hydronephrosis usually of the congenital intermittent type. On the right, favorite sites of stones in the ureter are shown (*B*, *A*, *C*); *D* indicates the usual type of large stone blocking the pelvis; *E* indicates suppurative infarction in the cortex of a hydronephrotic kidney; *F*, miliary abscesses.

Let us inquire into the diagnosis and surgical indications of a case of this type, the one I am about to offer for your consideration today—a man seventy-eight years of age, who, without prodromal symptoms, noticed complete cessation of the urinary function. The clinical history teaches us how insiduously destructive of the renal organs calculous disease may be; and how devoid of symptoms, how completely unconcerned of the existence of any hazard, a candidate for anuria and uremia may go about his daily pursuits.

III. ANURIA DUE TO BLOCKAGE

Case II.—Anuria of Six Days' Duration, Ureteral Bilateral Urinary Lithiasis, Ureteral Blockage, Without Pain, Nephrotomy and Decapsulation.—A male, seventy-eight years of age, is said to have been in good condition, having been up and about, except for what has been regarded as rare cardiac attacks, who has been living on his left kidney, the sister organ being the site of a calculous pyohydronephrosis. It was not until the other kidney became blocked by the impaction of a ureter calculus that symptoms set in, the only manifestation being *sudden suppression of urine.*

He is said to have had an attack of "retention" about two years previously (history taken November 16, 1920), this having been relieved by a catheter. On November 14, 1920 he merely noticed that he was unable to void any urine, believing his bladder to be empty. Shortly thereafter (a period of fourteen hours having elapsed) vomiting set in, and he began to feel dizzy and restless, and his bowels refused to move. Catheterization of the bladder drew forth merely purulent material, somewhat less than 1 ounce in total quantity. He went along for several days in this fashion, when on November 16th his pulse became rapid, 120; he vomited several times, his mentality was clear, and still he was able to get about, no urine having been passed for more than forty-eight hours.

On the fourth day after the onset of symptoms, after consultation, at which the possibility of ureteral blockage was suggested, cystoscopy and x-ray were carried out. x-Ray examination showed a large calculus, 2 inches by $\frac{3}{4}$ inch in diameter, in the pelvis of the right kidney, of the spearhead variety, with its tip abutting against the ureteropelvic junction, doubtless a stone that had caused obturation in that pelvis for some time. No calculus could be detected in the x-ray on the left side, but the plate was somewhat obscured by gas.

Cystoscopy demonstrated an obstruction at some 2 cm. above the *left* ureteral orifice, and no urine could be obtained from the left kidney. Catheterization of the *right* kidney evacuated a small quantity (about 15 c.c.) of turbid, watery urine, containing no urea or pus.

From this we could make the following tentative diagnosis: that the right kidney had been shut off for some time, was the seat of calculous disease with almost total inhibition of the function (possibly destruction) of the kidney; and that recently the left ureter had become occluded.

With a non-functionating right kidney, whose function was either inhibited or destroyed, and blockage of the left, and with a history of anuria, operation on the left kidney, the organ on whose secretory potentialities we could best rely, was advised, *but consent was withheld.* In such cases, therefore, there is nothing left for you to do but to make another attempt to overcome the ureteral obstruction with the cystoscope, which was done on November 17th, when it was possible to insert the catheter somewhat higher (about 6 cm.), a fairly large amount of thick purulent material being thereby forced to escape alongside of the catheter through the ureteral orifice.

You will not uncommonly encounter just such a condition of accumulation of *pus in the ureter*, when, by reason of ureteral inflammation and retention of urine in the kidney, pus accumulates in the lower end of the ureter by gravity.

When five days had elapsed without the passage of a drop of urine, acquiescence to operation on the part of the family was finally obtained.

Nephrotomy and Decapsulation for Anuria.—If you will follow me in this operation upon a patient who had run along for more than five days with total abolition of the renal function, two surprising circumstances may appear to you as worthy of note. First, that such a patient could still be in fairly good condition without any of the convulsive symptoms of uremia, an observation strongly insisted upon by Ascoli and other writers on uremia; and second, that immediate relief and immediate resumption of renal function measured by quantities of urine even above the normal should have followed immediately after decapsulation and drainage of the pelvis of the kidney.

We make the oblique Albarran incision of much shorter length than is our custom, since our objective is merely drainage of the kidney. As we expose the perirenal tissues, the inflammatory nature of the envelope and the edema are noteworthy, and, as the envelope is liberated, there is a gush of bloody urine due either to rupture of an attenuated portion of the renal cortex, or the enormously distended renal pelvis. I shall not investigate just where this urine comes from, for I believe it is unimportant. It would appear to be probable that it has its source in the rupture of the pelvis, for you see how tense and board-like and how hard the kidney itself is. We lose no time, but proceed rapidly with decapsulation; we penetrate the cortex behind the midline somewhat below the middle in the "bloodless" area of the kidney with a dressing forceps, explore the kidney pelvis for stone, find none, insert a tube, control some of the oozing by a packing, drain the perirenal space with a tube, and suture the walls in the usual way.

Further Course.—You have asked me what has become of our old patient with a protracted anuria. Within the first three hours after nephrotomy 2½ ounces of urine were passed through the drainage-tube, the first urine evacuated since more than five days. During the first twelve hours the urine was quite bloody, as we expect in nephrotomies on congested kidneys of this type. More than 30 ounces were collected during the first twenty-four hours after the operation, the patient's mentality being clear, although the pulse remained rather rapid. On the second day 51 ounces were measured through the drainage-tube, and but 4½ ounces were voided, the latter probably representing some of the secretion from the other kidney. The patient went along for six and a half days after the operation, the renal function remaining good, succumbing finally to cardiac failure. While the lethal outcome in this case must be admitted, the recovery of the kidney after operation, the persistently good function, and observation on other cases should convince you of the great value of the procedure of nephrotomy and decapsulation in cases of this type.

Renal Lithiasis and Chronic Nephritis with Anuria.—So also the cases in which Bright's disease has been diagnosticated, whose occasional painless hematuria and ill-defined backache have been interpreted in the light of manifestations of chronic nephritis, may, in truth, be the victims of the deleterious effects of urinary lithiasis, and go to a fatal issue through the exciting influences of the latter affection.

So let me discuss with you today this example of my thesis.

Case III.—Clinically Bright's Disease; Bilateral Ureteral Blockage Due to Stone.—This man's case is of great interest because it teaches how we may underestimate the gravity of the situation in a man who is sent to us for hematuria and "kidney disease" if the coexistence of calculi be unsuspected, and what errors we may make if we do not insist that such patients be cystoscoped when a diagnosis is doubtful.

He (fifty-five years of age) was referred to me with a history of occasional vomiting, sometimes vertigo and headaches lasting from two to four hours, these symptoms coming on at intervals of about two months, and persisting up to the present time. At times he would have burning on urination with some nocturnal frequency. He had had many *x*-rays taken, none of these revealing anything suggestive. During the past three years he has had *edema* of the legs with dyspnea. On occasions there were periods during which he urinated very small quantities. Six months ago he is said to have passed sand, with symptoms of burning on urination. He had two attacks during the last four months, and directly thereafter noticed that the urine was bloody. He consults me because of an attack of hematuria three days ago, and because of the chronic backache.

Urine examination (May 12th) showed a large quantity of albumin; sugar negative, many hyaline and granular casts and some blood. Blood-pressure 230, diastolic 190. The patient refused cystoscopy.

In view of the backache followed by hematuria, and since the existence of calculi could not be ruled out (although the *x*-ray examinations made were negative), you should report to the doctor (as I did) that you would prefer not to take care of the patient unless he submit to cystoscopic examination.

Since the symptoms did not disappear and the hematuria persisted, he finally consented to cystoscopy five days later. There were definite evidences of *retention of urine* in the renal pelvis. The specimens contained many clumps of pus-cells. *Diagnosis:* Infected hydronephrosis (with calculus in the right ureter); on the left, infection, possibly also with calculi.

Because of a very severe attack of renal colic on the *left side* on May 22d (six days later) cystoscopy was done on the 23d, marked retention of urine being found in the left kidney (opposed to the other side at the last examination) and about 45 c.c. of dark drownish retained urine were collected. This contained microscopically many white blood-cells and some red blood-cells. Therefore a stone had passed into the left ureter, causing damming back of urine.

No specimen was obtained from the right.

Diagnosis: Stone also in the right ureter with no flow from that side; obstruction at about 18 cm.; blockage also of the left ureter.

He had evidently passed calculi in the interval between the 16th and 23d of May into both ureters, establishing a proved infected hydronephrosis on the left side and *complete blockage* of the right.

Now, uremic symptoms began to make their appearance, and his mentality was not clear. On May 24th, the day after cystoscopy, in spite of the fact that the left kidney was drained of its retained fluid, there was evidence of *anuria*, since practically no urine was drained for a period of twenty-four hours, symptoms of uremia becoming more and more pronounced.

So another cystoscopy was done yesterday. An obstruction was again encountered at about 17 cm. in the right ureter; *no urine was obtained.* The obstacle in the left ureter was overcome, and about 45 c.c. of dark brown fluid were evacuated from the left ureter. The catheter on this side was then allowed to remain in the left kidney.

Are the conditions in this case clear to you? Both ureters have become blocked by stone. I was able to drain the left with the ureter catheter which was left *in situ*, and *on two occasions I was unable to get a drop of urine from the right kidney;* for a stone was evidently lodged 18 cm. above the bladder. The house physician tells us that the drainage through the ureter catheter from the left kidney has been inadequate, that his general condition is not improving, and that there was *no urine in the bladder.* This means that the right kidney has still been unable to expel any of its contents downward into the bladder. What shall we do? Shall we operate on the left kidney or on the right? It is evident that in the left kidney, at least, we have been able to enter with our catheter, while the right is completely shut off, *so I shall decide to explore the right side.*

Operation—Nephrotomy, Ureterotomy, Decapsulation.—Now I am exposing an extremely hard, tense, and enlarged kidney. See how enormously distended the ureter is in its upper portion; and as I palpate I feel the stone exactly corresponding in situation to the point where the ureter catheter met the obstacle, well incarcerated in a narrow portion of the ureter. Do you see how this small incision permits the catheter to be easily extracted, and that one suture closes the ureter? I am now making a small opening into the kidney, inserting a drainage-tube, and decapsulating. There is quite a gush of urine from the kidney as I enter the cortex of the kidney with a dressing forceps, since this organ has been acutely distended.

Subsequent Course.—Drainage from the right kidney was immediate, copious, and in forty-eight hours the patient voided a fairly good quantity.

In spite of the restoration of the renal activity, however, the patient became uremic again six days after the operation, exitus occurring on the seventh day.

Ureteral Calculus with Reflex Anuria.—Although it is well recognized by the urologist that unilateral ureteral obstruction by a stone, particularly by a descending ureteral calculus, may be followed by reflex suppression of urine, the urgency of instituting immediately very simple methods of relief is not universally recognized nor accepted by the internist. Therefore, not only for diagnostic purposes but for rapid amelioration or even complete abatement of symtpoms, should you have recourse to cystoscopy and ureteral catheterization, for this you will find is a most reliable means for renewing the activity of the kidneys.

In your practice you may meet with two distinct types of suppression of urine due to impaction of a calculus in the ureter, and these, for the sake of the discussion of therapeutic measures, may be grouped as follows:

First: Single or repeated attacks of suppression of urine, due to a calculus usually in the lower end of the ureter, permanently relieved by the passage of the ureteral catheter, with or without the early expulsion of the stone.

Second: Single or repeated attacks of reflex anuria or suppression of urine from the same cause, relieved by the same method, until the impaction becomes such that ureteral catheterization becomes impossible, ureterotomy being indicated.

With the acquisition of sufficient skill in the manipulation of the ureter catheter you will find that most cases of suppression of urine can be relieved by cystoscopy alone. It is a peculiar circumstance, and one worthy of note, that most symptoms of intestinal obstruction, and those of reflex anuria, are more apt to occur when the ureter calculus is impacted in the pelvic portion of the ureteral tract. It is in this situation that my two-catheter method of manipulation will rarely fail to mount the obstacle and to drain off the retained urine from both ureter and the pelvis.

One or both catherers must then be allowed to remain *in situ* for a sufficiently long period of time to awaken the inhibited function of the other kidney, as well as to thoroughly drain the affected side.

What should this period be? This will depend upon the duration of the suppression of urine, the difficulty we have experienced in overcoming the obstruction, the amount of edema of the ureteral orifice, and our appraisal of our subsequent chances of being able to pass the catheter again, if occasion should require. Where the suppression of urine has lasted for a considerable period of time it will be wise for you to allow the catheter to remain for several hours, possibly overnight, or even longer. So also, when the edema of the orifice is marked, and the difficulty attending the surmounting of the obstacle was great. When, however, the ureteral blockage does not seem to be so marked, and where previous attacks of ureteral colic and the passage of stone has dilated the ureter considerably, and our estimate suggests an easy repetition of these cystoscopic manipulations, it may be permissible to be satisfied with a ureteral drainage over a period of half an hour or an hour.

Reflex Anuria that Responds to Ureteral Catheterization.—Let me bring to your notice a concrete example of such a case, so that you may not be in doubt as to the preferability of non-operative procedure when you are confronted with a similar clinical picture.

Descending Ureteral Calculus, Intense Renal Colic, Suppression of Urine, Complete Relief by Drainage with the Ureter Catheter.—J. B., fifty-six years of age, male, had had a similar attack of renal colic fourteen years previously, and then another attack three years ago, both of which subsided spontaneously.

x-Ray examination on December 29, 1920 showed an elliptic shadow $\frac{5}{16}$ x $\frac{3}{16}$ inch in the path of the right ureter, about 3 cm. from the site of the bladder orifice of the ureter.

Because of suppression of urine lasting some eighteen hours the patient was brought to the office on December 30, 1920, and cystoscopy demonstrated an obstruction in the right ureter just above the orifice. By manipulation with two catheters it was possible to insert a catheter beyond the obstruction and drain a considerable amount of bloody retained urine, and because of the suppression it was decided to leave the catheter *in situ*. For this purpose the patient was transported to the hospital, where the catheter drained copiously from the kidney. At 10 P. M. on December 30th (the same day) blockage of the ureter catheter had evidently taken place, and it was manifest that this was evidenced by an attack of intense colic, which was immediately relieved by overcoming the obstruction in the ureter through the injection of some boric acid. On the following day the patient voided normal quantities of urine alongside of the catheter, and on January 1st the catheter was removed, the patient having completely recovered.

Reflex Suppression of Urine Due to Impacted Ureteral Calculus Requiring Ureterotomy.—It is in the cases in which your efforts to pass the obstacle with the ureteral catheter are unavailing that you may have to resort to ureterotomy. Were it not for the fact that with our modern methods of cystoscopic manipulations so large a percentage of the ureteral stones can be made to pass without operative intervention, this expression of therapeutic indications would be quite beside the point.

Now and then you will encounter cases in which hopes of conservative treatment will be shattered by the sudden lodgment of the stone at a point where the ureteral catheter will no longer be able to pass, and by the synchronous onset of suppression of urine. I have elsewhere brought to your notice in demonstration of other cases how such suppression of urine can be relieved. Now permit me to confer with you regarding another example, in which two attacks of suppression of urine occurred, one of which could be relieved, and the other not, merely because the ureter catheter could no longer be depended upon.

Descending Ureteral Calculus Lodged in the Lower Pelvic Ureter, Continuous Renal Ureteral Pain; Relieved by Ureteral Catheterization; Subsequent Attack with Suppression of Urine; Relieved by Ureteral Catheterization; Second Attack of Suppression of Urine, Necessitating Ureterotomy.—R. M., thirty-eight, female, whom I present to you today, is a woman whom I found in bed, with a history of having been bedridden for two weeks, with almost continuous pain in the left lumbar region. At times she says that she had intervals of relief, particularly when morphin was administered. Some of the paroxysms of pain were severe and attended with vomiting. About seven months previously she had had a similar attack, and these had been repeated about once a month, and since she had to remain in her bed, two weeks ago.

When you find cases that have undergone a protracted period of pain, evidently due to renal or ureteral stone, it is best to *counsel the application of the cystoscope immediately* rather than to temporize with *x*-ray alone. The passage of the ureteral catheter beyond the obstructing ureteral calculus may give relief at once, besides expediting the passage of the calculus; while morphin is but an exceedingly evanescent, therapeutic measure. A vaginal examination in females will often clear up the diagnosis at once, since incarceration of the stone in the pelvic course of the ureter not far from the bladder is a most common occurrence. It is in this situation that the most marked symptoms are produced, reflex ileus most likely, and even suppression of urine. Through the anterior vaginal wall such calculus can be easily detected, and so it was here at the very first examination.

If you look at the *x*-ray plates of this case you will see an ovoid shadow $\frac{7}{16}$ inch by a little more than $\frac{5}{16}$ inch in the course of the left ureter just above the ischial spine. Both kidneys are normal in size and position. The cystoscope passed (February 28, 1921) permits the left ureteral catheter to demonstrate an obstruction in the left ureter 4 cm. from the orifice in the bladder. But by manipulations the catheter slipped by the retention of urine above the obstruction demonstrated, the urine containing numerous red blood-cells. You will not be surprised when I tell you that relief from pain was obtained.

After you have emptied such a dilated ureter and kidney in a case of ureteral impaction, and given the long-sought-for amelioration, it will be wise for you to call the patient's attention to the fact that his or her suffering may not be altogether at an end, but that a repetition of the attack is frequently to be expected. Although many of the cases—when the stone is small—will be gratified by an early expulsion of the calculus after one cystoscopic treatment, others will have to undergo a repetition of the ureteral colic, and I therefore advise strongly that after such instrumentation your patient be instructed that another paroxysm may not only occur, but is a *desideratum, in that it may signalize the further descent* of the stone.

So here, although relief was obtained for twenty-four hours, another attack then occurred with suppression of urine.

You will then pass the catheter once more, as was done here. You will find that the urine will pour out in a steady stream with considerable rapidity through the ureteral catheter as you pass the obstruction, and will do well to leave one or two catheters *in situ* for half an hour or more. Now our patient has had relief for three days, had almost refused further manipulations, when a period of twenty-four hours elapsed *with the passage of but* 3 *ounces of urine.* With this there was considerable pain and discomfort in the iliac and lumbar region, so that the indications were cystoscopy alone, or cystoscopy and ureterotomy.

On March 5th I find that I am unable to pass the ureteral obstruction, and, in view of the suppression of urine, there is naught else for me to do but proceed with ureterotomy.

So on March 5, 1921 the ureter is exposed, and found dilated, inflamed, cyanotic, distended with urine, and the ureter stone about ½ inch in diameter, tightly impacted about 1¼ inches above the bladder, from which it could not be dislodged, so that incision had to be made *in situ.* From then on uninterrupted recovery.

IV. PERFORATIONS OF THE URINARY TRACT

The dangers of too much procrastination in the treatment of ureteral calculi, and the error of judgment that will permit the physician to allow a patient to disregard an obstructing stone because symptoms are absent, are practically confirmed by the perforations of the urinary tract due to the pent-up urinary secretions. No definite prognostication can be made as to just what form of lesion will characterize the alterations in the pelvis of the kidney, the kidney itself, and the ureter by reason of ureteral obstruction. In fact, a multitude of changes may be produced under varied conditions, since a number of different factors play an important rôle in their elaboration. First, you must remember that the lodgment of a calculus in the ureter may at one time produce dilatation of the ureter and kidney by virtue of continued excretion from the kidney, and impaired outflow, and, on the other hand, may be signalized by a total arrest of the excretory function. A careful study of the character of the ureter in the cases in which ureterotomy is performed will attest to the fact that an empty ureter is not an uncommon finding. Although the absence of urinary flow through the ureter catheter when it cannot pass the ureteral obstruction is no indication of the non-existence of the retention of urine above the obstacle, *x*-ray examination in a large number of my own cases has confirmed the operative findings in the presence of a small kidney on the side of the obstruction.

Conversely, more or less acute obstructions are apt, when suppression of urine does not take place, to be attended with considerable dilatation of the ureter, particularly when by reason of former attacks some uronephrosis or hydronephrosis of the kidney has already taken place.

The rôle played by infection, too, is an exceedingly important one, in that it is responsible for alterations not only in the kidney cortex inself but also in the pelvis of the kidney, and in the ureter. Thus, dilatation of the ureter and extrarenal pelvis are not uncommon sequences of inflammatory processes alone.

Furthermore, the conformation of the urinary tract, which, as you know, is prone to anomalies, is another important factor in determining the ultimate lesion.

The resistance of the body, too, and the type of bacteria seems to be influential in shaping the pathologic anatomy. For how else could we explain those slow perforations of the pelvis or ureter due to calculus, that must needs have taken months to occur, with peripelvic or periureteral protective adhesions of inflammatory fat—characteristic of certain cases—and perforations of the extrarenal pelvis and cortex of the kidney in others, where no adhesive processes or supporting changes can be found.

Perforations of the Urinary Tract.—Let me pass in review just a few examples of such cases, and discuss how the surgical indications will have to be met.

When a perforation occurs it may involve the ureter in any portion, the extrarenal pelvis, and the cortex of the kidney.

Perforations of the ureter are most apt to be situated in the lower pelvic course of the ureter, and in the upper lumbar.

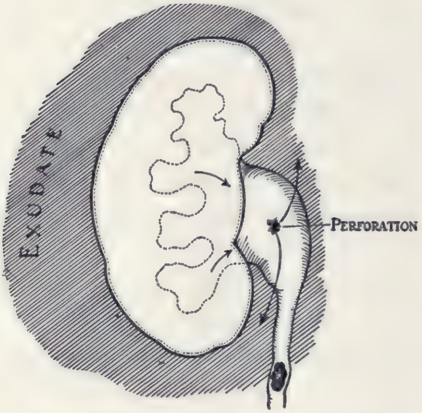

Fig. 177.—Pararenal and parapelvic urinary exudate following perforation of the pelvis, with calculus blocking the ureter.

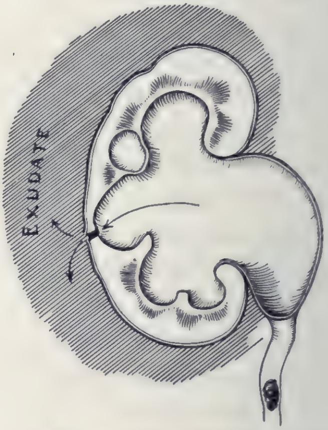

Fig. 178.—Perforation of attenuated hydronephrotic kidney consequent upon ureteral blockage with perirenal urinary extravasation.

Perforations of the pelvis may occur in any portion of the extrarenal pelvis, and those involved in the cortex may or may not be accompanied by rupture of the capsule of the kidney.

Thus, we may divide the urinary extravasations that occur after a perforation as follows:

1. Parapelvic and pararenal (Fig. 177).
2. Perirenal extravasation (Fig. 178).
3. Periureteral extravasation (Fig. 185).
4. Subcapsular extravasation (Figs. 181, 182).

A glance at this chart that I will show you will help explain the situation of the exudate when the urinary fluid has made its escape from the reno-ureteral system.

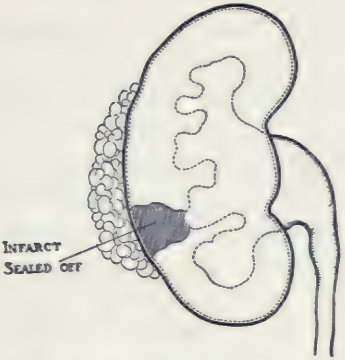

Fig. 179.—Cortical infarction leading to a calyx with protective inflamed fat sealing it off.

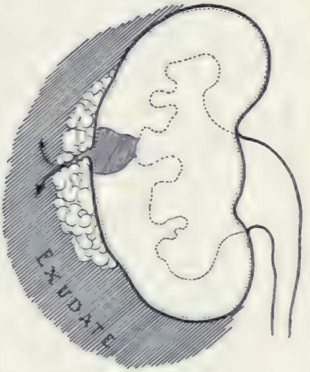

Fig. 180.—Perforation of the protecting fat causing communication between calculus and perirenal tissues.

In Fig. 177 there is a diagrammatic representation of a perforation of the pelvis of the kidney due to distention and blockage by a calculus in the upper ureter, with a pararenal exudate of urine, the latter infiltrating the fatty tissues about the kidney, the pelvis, and the upper ureter.

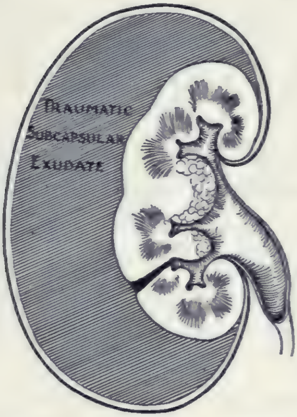

Fig. 181.—Traumatic subcapsular exudate with laceration of kidney establishing communication with calyx.

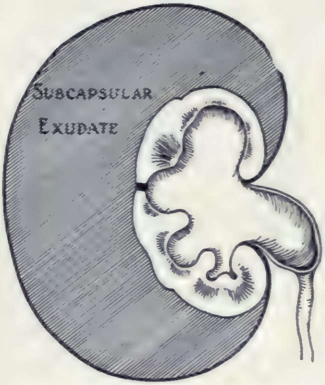

Fig. 182.—Subcapsular exudate accompanying ruptured hydronephrosis, usually of congenital atrophic type.

Where there is a perforation of an attenuated cortex in a hydronephrotic kidney, and the capsule is perforated simultaneously, a perirenal exudate as seen in Fig. 178 is the result.

Anemic infarction combined with suppurative infarctions have, in my experience, been seen to be sealed off by inflammatory fatty tissue, so that any communication with the pelvis outward is kept closed (Fig. 179).

But, when by reason of suppuration of the fatty protective envelope, or by blockage of the ureter, a communication is established, the urine finds its way outward as depicted in Fig. 180.

Subcapsular exudates may accompany traumatic rupture of a fairly normal kidney with collection of urine under the capsule, the latter being intact (Fig. 181).

It is not uncommon, however, to find a congenital hydronephrotic kidney, usually of small size, giving rise, by virtue of perforation, to a subcapsular exudate of urine (Fig. 182).

(*a*) **Perirenal Urinary Extravasation.**—Permit me to bring to your notice one of the worst of the forms of urinary extravasation around a kidney, where the proper method of liberating the urinary tract was not applied in good season; a case in which the patient's life was placed in jeopardy, the kidney compromised, a long period of hospital care required, with nephrectomy as the final outcome.

Perirenal Extravasation of Purulent Urinary Exudate Due to Blockage by Ureteral Calculus; Drainage of Perirenal Abscess; Secondary Nephrectomy.—A very sick man, forty-five years of age, with a temperature of 103° F., pale, presents himself for examination on September 18, 1920 (referred by Dr. A Granet) because of intense pain in the left lumbar region, fever, and with a history of having been as sick as this for almost two weeks. A glance at the lumbar region with the patient stripped demonstrated a large swelling with bulging in the costovertebral area and flank extending diffusely as far as the anterior axillary line. This mass gives a sense of deep fluctuation.

The urine is cloudy and contains considerable pus.

One would suspect perforation of the kidney with extravasation of urine and pus, possibly associated with a hydronephrosis.

Cystoscopy demonstrated an insurmountable obstruction about 10 cm. removed from the left ureteral orifice, with a total absence of flow from the left kidney. The right kidney functionated fairly well, although the output of phenolsulphonephthalein was only about 16 per cent, as judged by the total bladder urine over a period of two hours.

x-Ray examinations show a shadow over the middle of the left iliac synchondrosis, suggesting a calculus about $\frac{1}{2}$ inch in diameter.

Diagnosis.—With the evidences of total obstruction of the ureter at hand, the bulging mass in the left flank, the diagnosis of infection of the left urinary tract with possibly ruptured hydronephrosis seemed the most likely expression of the anatomic condition. That such interpretation was the correct one was demonstrated by operation done in the evening of the same day.

Operation.—If you will follow me carefully through the description of an operation for a suppurative process in and around the kidney, a number of valuable points obtained from experience may be worthy of your attention. With careful technic, on the one hand, and with the utilization of correctly applied Carrel-Dakin treatment, suppuration of the rather large incision that kidney frequently requires, need no longer be feared.

In the technic, three points may deserve emphasis: First, the restriction of the size of the incision, where exploration will not be necessary and where we expect to find pus just under the lumbar fascia (as in perinephritic processes and extravasation of urine).

Second, the evacuation of the exudate or pus in the kidney with as little soiling of the wound as possible.

Third, correct methods of suture with the proper placement of wound drains.

The Surgical Technic in Infected Kidney Cases.—Let me, therefore, digress for a moment before continuing with the case I am presenting to you, with a consideration in somewhat greater detail of the recommendation above alluded to.

1. *The Incision.*—For more than 90 per cent. of the ex-

posures of the kidney (for whatever lesion may be present) we advise a modified Albarran incision (Fig. 183) that crosses obliquely from a point somewhat above the anterior superior spine upward and backward to the costoveretebral angle just under the twelfth rib. It is but the posterior portion of this incision that is necessary in the cases when we expect to find pus under the parietes. Where further exploration is necessary for the finding of pus, or where the kidney may have to be exposed so as to be properly drained, or a calculus removed through the cortex, a larger incision is necessary.

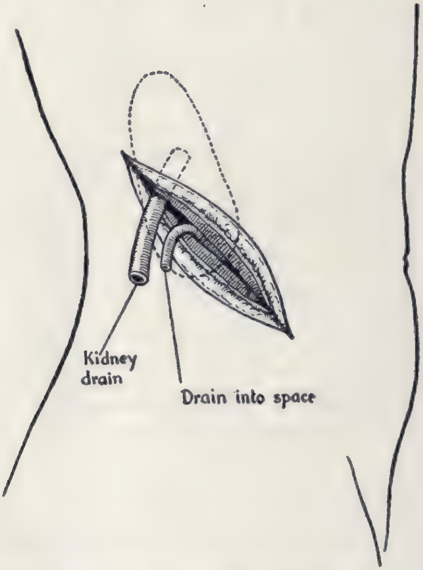

Fig. 183.—Albarran incision with relative situations of kidney and drains indicated; the kidney drain enters the kidney postero-inferiorly, and the depth drain emerges next to the latter, draining the perirenal space.

2. *Technic for Evacuating the Pus.*—If we wish to obtain primary union throughout most of the wound in cases of infection of the kidney or perirenal tissues, it will be well to cover thoroughly the cutaneous, subcutaneous, and muscular tissues with towel and gauze pads, also packing off thoroughly the fatty perirenal tissue. This, however, is not sufficient, and you may

find the following expedient to be of some technical value. Should you expect to find pus immediately under the lumbar fascia, a prognostication that is not difficult, the alterations in the partial plane, such as bluish-pink discoloration, congestion, edema, and thickening are carefully noted—you may perforate this region with a trocar, evacuating most of the pus in this way. Or you may insert a dressing forceps, followed rapidly by the insertion of a tube of adequate dimension, and so also empty the pus without any or very much spilling. So also when you determine upon evacuating the contents of a dilated pelvis of the kidney, you may either use the trocar followed by the insertion of a tube carried in with a curved artery forceps, or a catheter may be directly led into the renal pelvis through a minute opening in the cortex, preliminary escape of fluid being controlled by the left hand. It is not a little gratifying to see how beautifully the wounds even in such infected cases will heal if these measures be carefully followed.

3. *Closure of the Wound Itself.*—Since the adoption of these details in operative technic we have not had the occasion to open widely a single infected nephrotomy or nephrectomy wound. In closing, use catgut only and interrupted sutures in about two layers, avoiding excessive use of suture material. If the posterior angle of the wound gives exit to the tube draining the kidney or perirenal exudate, it is well to insert an additional tube into the perirenal space beside those that will superficially drain the parietes (Fig. 183). A tube of small caliber is led under the skin downward and forward, so as to drain the posterior portions of the musculature, and may emerge together with the other drain. If the incision is large, an additional small tube of Carrel-Dakin caliber may be inserted into the skin, through the skin at the antero-inferior angle of the wound, and, in the worst cases, another is placed between the sutures at about the middle of the incision. These small tubes are employed not only for the purpose of drainage, but for the early injection of the Dakin solution, should this become necessary (Figs. 183, 184).

Further Clinical History of Our Case.—The usual but shorter oblique incision discloses inflammatory signs, adhesions between the deeper structures of the muscle fascia, and some edema. A dressing forceps is now thrust through the fascia and the opening at once closed with the finger, so that the pus cannot soil the rest of the wound. A large tube now rapidly replaces the finger and evacuates two large pus basinsful of foul, purulent urine.

What shall be the further steps in a case of this sort? With a patient in poor condition, a large perirenal exudate, with the other kidney functionating badly (about 16 per cent. phenolsulphonephthalein), the immediate indications will have been met when the pus and urine will have been given a free outflow. Nor will exploration of the large cavity with the finger reveal very much as to the exact anatomic condition, nor will it help us to diagnosticate between a perforation of the extrarenal pelvis or the cortex of the kidney itself. We shall content our-

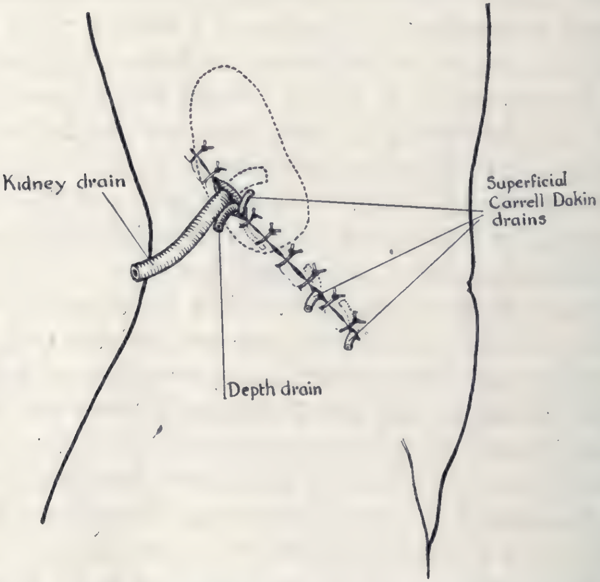

Fig. 184.—Method of closing the wound in infected kidney cases where the kidney is drained (by kidney drain); the latter emerges at a point nearer the postero-inferior end of the incision; the depth drain is adjacent to it, and the small Carrel-Dakin tubes are inserted at two or three places under the skin.

selves, therefore, with the correct treatment of the wound, which is to be carried out in the manner previously suggested. In truth, it was not until at a later date when the kidney was removed that the pathologic anatomy was fully cleared up.

Future Clinical Course.—In such a case we would recommend the early use of Carrel-Dakin solution, with which excellent results are obtained. Indeed, except at the point of drainage, the wound here healed up by primary intention. Thus, the general condition of the patient did not permit further intervention until January of the following year, about three months later. Although such a patient may be up and about, as was this one, you must hesitate in suggesting further operative measures until you feel confident that he or she may be in a condition to weather further surgical procedures.

Indications for Nephrectomy.—What shall the conduct be in a case of this sort, with an insurmountable ureteral obstruction 10 cm. from the bladder? Shall we remove the perirenal drain? Shall we take out the kidney? Shall we operate on the ureter? These are the questions that you must be prepared to answer.

Obviously, nephrectomy will be indicated when the kidney has already been destroyed if the patient's general condition will permit. The function of the affected kidney can be approximately appraised by the phenolsulphonephthalein output through the drainage-tube, which in this case was almost zero after the operation. But you must also resort to a further procedure to get a more accurate estimate, namely, to ureteral catheterization for subsequent information; for in the interim the ureteral obstruction might spontaneously be relieved through migration of the stone, allowing urine to seek its normal path.

Cystoscopy, therefore, was done on several occasions, and the obstruction found to be repeatedly insurmountable.

The general condition of the patient and the function of the other kidney now are to be considered as the guiding factors in our decision as to the advisability of nephrectomy. Can we rely in such a case on the phenolsulphonephthalein output and the retention of nitrogenous products in the blood alone?

As far as the phenolsulphonephthalein output is concerned, do not rely too much upon it as affording testimony of impaired renal function, for here I am presenting to you a man whose left kidney function was less than 25 per cent. even after drainage of the left perirenal exudate, in whom nephrectomy was carried out without any complications. Remember that continued toxemia due to absorption from a purulent focus may inhibit and impair the integrity of the other kidney to a considerable extent. So be guided rather by the general condition of the patient, and if there are no marked signs of retained nitrogenous products, you will find that nephrectomy will be well borne.

Let your patient, therefore, get about with the drainage-tube in place, keep the latter clean, build up his general condition, and if you feel confident that the ureteral obstruction cannot be overcome, and the kidney function on the corresponding side is so poor that its retention is of no value to the patient, then approach the consideration of doing what was done here—a *subcapsular* nephrectomy.

Subcapsular nephrectomy was carried out on January 10, 1921. The kidney specimen, when examined, demonstrated the fact that a perforation of the extrarenal pelvis must have taken place, the cortex of the kidney itself being intact throughout. The usual lesions of hydronephrosis, marked dilatation of the pelvis, chronic pyelonephritis, and ulcerations of the papillæ were present.

The patient made an uneventful recovery after nephrectomy.

(*b*) **Retroperitoneal Periureteral Extravasation of Urine. Spontaneous Rupture of Renal Pelvis of Hydronephrotic Kidney Complicating Ureteral Blockage by Stone.**—Perhaps no more unexpected and unusual an instance of *recovery* after an operation on the urinary tract has come to my notice of recent years than the following case of bilateral urinary lithiasis that I wish to offer for your consideration today. Not only was the spontaneous closure of a urinary fistula striking in this case, but the whole clinical course and data obtained from cystoscopic examinations offer an unusual amount of food for thought and clinical deduction.

In a man with bilateral urinary lithiasis, with one infected kidney and with an obstructing calculus in the ureter of the other side, the complications and jeopardy to life that a timely removal of the ureteral calculus in the healthy tract could have obviated are beautifully illustrated. It is examples such as these that are the best clinical lessons in surgical indications.

With the right kidney previously removed for infection, and with the synchronous lodgment of an obstructing calculus in the ureter of the remaining urinary tract, the problem of treatment would seem clear, namely, the early liberation of the affected ureter. The ureteral stone having been allowed to remain, however, our patient comes to us in *critical condition*, with the left kidney function almost completely in abeyance, with his solitary ureter obstructed, and with an infection of the whole supravesical urinary tract; and thus has to run the gamut of complications that all but cost him his life.

An analysis of such cases speaks volumes in favor of the supreme *importance of liberating the healthy* urinary tract, when the other side has been compromised beyond repair. So let us consider the following:

Acute Infection of Solitary (Left) Urinary Tract, Impacted Ureteral Calculus, Ureterotomy, Persistent Urinary Fistula Closed by Drainage of Perirenal and Periureteral Urinary Exudate Due to Spontaneous Perforation of Infected Hydronephrosis.—No more unexpected result has come to my notice of late years than this instance of restitution of a solitary ureteral tract, whose *apparent* impairment of continuity bid fair to require permanent nephrostomy or nephrotomy.

L. L., age thirty-one, male, was first seen on December 3, 1918, the story being that he had had pain in the *left lumbar* region ever since being discharged from a hospital in the spring of 1918, the right kidney having been removed for calculus and infection. Already at that time he is said to have had a stone in the left ureter.

For two days he had had chills and high fever (103° to 104° F.), had been irrational at times, had passed some turbid urine in exceedingly small quantities, the pain in the left lumbar region being very severe.

In short, symptoms of blockage of the left ureter by a ureteral stone complicated with infected hydronephrosis.

Cystoscopy (December 4th) showed an intensely inflamed bladder, a very much swollen left ureteral orifice, and an obstruction *at the orifice*, probably due to edema. This was overcome with the catheter, when suddenly a gush of practically pure pus followed. The catheter could then be passed upward without detecting the obstacle, and about 30 c.c. of purulent urine were collected within an exceedingly short time, the continuation of the flow and its character indicating that there was probably much more in the kidney and ureter.

The *x*-ray examination revealed a triangular calculus in the course of the left ureter on a level with the ischial spine, a point above the edematous obstructed orifice.

It seemed correct to assume, therefore, that we were dealing, anatomically speaking, with an inflammatory narrowing of the ureter at the vesical outlet, above which almost pure pus had collected (ureteritis or gravitation of pus), with a second veritable obstruction about 3 or 4 cm. above this, due to a stone that hypothetically was not a true obstruction in the centripetal sense, but was an effectual barrier to the outflow of urine in the descending or centrifugal sense.

Early intervention seemed indicated. The question then had to be answered, "Should we operate on the ureteral calculus, which was below the pelvic brim, and remove it; should we do a nephrotomy first, or both at the same time, in view of the high temperatures and apparent severity of the renal infection?"

On December 5th it was decided to go in on the left ureter in the usual fashion through a pararectal incision rather than to expose the kidney.

On making the usual incision an interesting finding was encountered, namely, intense edema in the neighborhood of the ureter and in the whole left *iliac fossa* and retroperitonal region. No definite urinary odor was detected, although not sensed for or suspected as possible at the time. The quantity of fluid was noteworthy, however. The ureter was found considerably dilated up to about the pelvic brim, where there was only slight dilatation. The calculus was found about 3½ cm. from the bladder. It could be milked up with some difficulty and removed at a point in almost normal ureter, a sort of pyramidal shaped or conically shaped stone, somewhat smaller than in the picture, being delivered. The usual closure in layers with drainage at the lower angle was carried out. The ureter itself was markedly inflamed, the lower part markedly edematous and thickened.

Although the patient made an excellent postoperative recovery, we were not a little concerned by the *persistent urinary leakage* that took place through the lower angle of the wound. Immediately after the operation and for several days thereafter he complained of exquisite pain in the left lumbar region, and his temperature rose to 103° F. Because of the patient's unbalanced state, his irrational conduct, and almost maniacal tendencies during the first week after operation the importance of the local signs referable to the left loin was underestimated.

As soon as the temperature began to drop and a more calm mental attitude was established, we felt that the suburemic stage had been passed and the outlook appeared more promising. After the second week it seemed that all would be well except for the fact that slight recrudescences of fever occurred from time to time, and the urinary leakage continued.

Cystoscopy on two occasions late in December and early in January demonstrated an obstruction in the lower ureter, so that it could be assumed that the urinary leakage was due to an inflammatory stenosis of the ureter below the point at which ureterotomy had been performed. A circumstance whose significance was not clear at this time, but which seemed explicable in the light of future events, was the fact that although urinary leakage in some quantity or other was present daily, the drainage of urine down into the bladder was large in amount, from 40 to 70 ounces daily. The obstacle encountered in the ureter at cystoscopy, therefore, seemed of relatively little import, since urine in such amounts could traverse the lower ureter.

Finally, in view of the frequently recurring temperatures, and because of a distinct enlargement of the renal mass, it was decided to operate on the left kidney and perform a nephrotomy with either a temporary or permanent drainage, depending on whether a re-establishment of the patency of the ureteral lumen would occur.

On January 30, 1919 a small lumbar incision was made. It was immediately evident that the tissues were chronically inflamed. On cutting through the fascia, a large amount of purulent urine from about the kidney was evacuated. On exploration with the examining hand it was found that the urine occupied quite a large cavity between the kidney and the parietes above, and extended downward for a considerable distance, although no attempt was made to trace it to the ureteral fistula. A drain was put in and no further steps were taken to expose the kidney, the enormous amount of inflammatory scar tissue suggesting that the finding of this organ and its liberation might be fraught with unnecessary risks.

Future Course.—The patient immediately made an *uneventful recovery. Within a few days the ureteral fistula below closed*, and the wound cleaned up rapidly and healed within a week.

Conclusions.—What were we dealing with in this most remarkable case? Was it a true ureteral fistula or was there perforation of the hydronephrotic kidney with escape of urine into the perirenal tissues, the urine dissecting its way down the retroperitoneal space? (Fig. 185).

The immediate closure of the abdominal urinary leakage after the lumbar incision lends credence to the following view, that *a perforation of the renal parenchyma or renal pelvis* had taken place, and that an exudate was present for several weeks both in the loin and in the lower lumbar region; that the lumbar drainage allowed the kidney sinus to close, there being *no* ureteral leak. The escape of urine through the abdominal incision was altogether due to urine that had dissected its way down from the kidney along the ureter, and thus out through the wound. The large amount of fluid encountered in the retroperitoneal tissues at the first operation was possibly more than serous fluid of edema, and was perhaps urine that had escaped from the kidney—an unusual but conceivable condition.

How else could we explain the fact that immediately *after* *the lumbar incision* practically *all* of the urine entered the bladder, and the abdominal sinus became instantaneously *dry?*

Doubtless an opening (possibly a valve-like one) in the kidney or pelvis accounted for the persistent flow through the abdominal sinus, and so also the paradoxic situation of the synchronous drainage of 60 to 70 ounces of urine through the solitary ureter and the copious escape of fluid through the abdominal sinus can be readily understood.

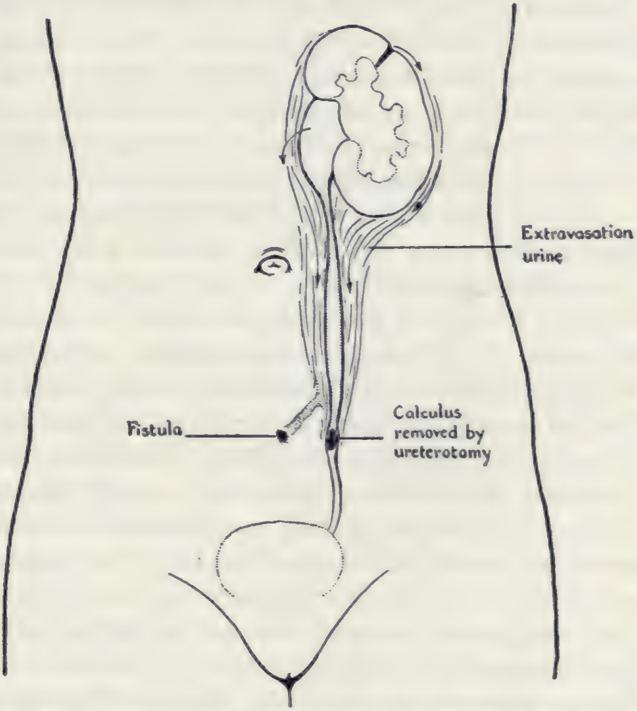

Fig. 185.—Diagrammatic representation of a distended kidney with dilatation of the pelvis and ureter, in a case in which a urinary fistula persisted by reason of the fact that extravasation of urine occurred as indicated.

From there on the patient's recovery was uneventful.

(*c*) **Perforation of the Ureter.**—You will find this by far less common than similar lesions of the extrarenal pelvis or upper lumbar ureter. That penetration of the ureter either in its pelvic course or high up is not necessarily incompatible with complete conservation of the urinary tract I may be able to demonstrate to you in the following beautiful instance of low penetration of the pelvic course of the ureter, and later on in an additional example of migration of a calculus from the lumbar ureter into a periureteral abscess.

D. A., female, thirty-two years of age, had been operated upon four years previously for some uterine trouble, and at that time her appendix was removed. She was catheterized after the operation; since then has had more or less trouble on voiding, with attacks of urinary frequency and pain in *right lumbar region.*

Two weeks ago she began to have very frequent attacks of colicky pain in the right kidney region, radiating to the right groin and thigh, associated with marked burning and urinary frequency, with voiding every fifteen minutes to one-half hour, and frequently during the night. There was some nausea and vomiting, but no marked rise in temperature.

On August 20, 1919 she was cystoscoped by someone, who is said to have found pus in the specimens from the right kidney, who met an obstruction in the right ureter, and who then proceeded to inject argyrol into the kidney (?) or ureter. Immediately thereafter the patient's temperature rose to 102° and 103° F., she was very sick, and on the 26th was admitted to a hospital in Brooklyn. A second cystoscopy was done, this being again followed by fever, chills, and *suppression of urine.*

When seen by me in consultation on September 1, 1919 she had had temperature for several days. There had been an attack of *convulsions* on August 31st, during which the patient was unconscious for half an hour, and there was a repetition of the convulsion on the morning of this day, no urine having been secreted for some twelve hours.

In short, in a patient who gave symptoms of right renal colic, who on cystoscopic examination seemed to have an obstruction in the lower pelvic ureter on the right side, and in whom on two occasions cystoscopy was followed by high temperatures and chills, who now was beginning to show the symptoms of urinary suppression, it was expedient to determine whether the intact organ was sufficiently healthy to permit of operative intervention, to decide as to whether the patient was in condition for operation at all, and to make an exact anatomic diagnosis as to the existence of a calculus on the right side, since the *x*-ray examination already done had proved to be negative.

Cystoscopy, September 2, 1919: There was an obstruction to the passage of the ureteral catheter in the right ureter at a point 5 cm. removed from the bladder orifice of the ureter, no flow being obtained from the right kidney. A shadowgraph catheter was inserted. There was a rather scant flow from the healthy side (the left side), but a sufficient amount was collected to show that phenolsulphonephthalein was excreted.

Tentative Diagnosis.—Calculus in the right ureter at 5 cm.; inhibition of the function of the left kidney.

If you will follow me through the findings at operation, a number of interesting points will be developed for discussion.

Right ureterotomy for calculus in the ureter, *resection of perforated ureter*, *ureterorrhaphy*. September 5, 1919, through the usual pararectal incision, extraperitoneal exposure of the right ureter was made, the tissues about the pelvic ureter showing the usual evidences of a very intense periureteral inflammation, the ureter being firmly bound down to the peritoneum, and in the true pelvis surrounded by an inflammatory exudate, which was dissected away with some difficulty. Low down in the pelvis the ovary could be recognized firmly embedded and attached to the peritoneum, to which the inflamed ureter was adherent. In carefully dissecting out the ureter and separating off the peritoneum mesially, an inflammatory exudate with granulation tissue was encountered, and in it the torn, perforated ureter was seen to lie. The edges of the large rent, which was practically complete, were seen to be covered by reddish-brown, partly organized blood-clots, indicating that the ureteral rupture must have taken place some time in the past.

About 2 cm. below this ureteral tear the calculus was found firmly attached and incarcerated in the ureter.

The character of the ureter in the region of the tear is worthy of your attention. The ureteral wall was so friable and reddened and inflamed as to resemble the mucous membrane stripped from out of the muscular coats of an inflamed appendix. Was this loss of continuity of the ureter beyond repair? No.

After the removal of the calculus the inflamed edges of the ureter were resected, about $\frac{1}{2}$ inch of the ureter being sacrificed, the ureteral lumen enlarged by one small longitudinal incision in each end, and ureterorrhaphy accomplished with fine interrupted chromic catgut sutures. A rubber-dam drainage was applied, and suture carried out in the usual manner.

Future Course.—The wound healed nicely except for a fistula that was established at the lower end, at the site of the drainage, leakage of urine being continuous for fourteen days, when I decided to attempt to insert a ureteral catheter.

For, let me emphasize, it is the cystoscope with the retention ureter catheter that you will have to resort to, wherever you believe that a renal or ureteral fistula is perpetuated by a removable obstruction peripherally situated—be that obstacle an actual body (stone) or merely swollen mucous membrane.

Therefore, on September 16th cystoscopy was done, but an insurmountable obstruction was again met with at about 5 cm. from the right ureteral orifice, so that our very slight hope of obtaining ureteral union seemed almost shattered.

On October 4, 1919 it was decided to make another attempt to close the ureteral fistula by the insertion of a ureteral catheter, and, to my gratification, it was easy to pass a catheter into the right ureter. Its introduction was followed immediately by a very copious flow of cloudy urine, containing numerous pus-cells. The catheter was allowed to remain *in situ* about four days. Immediately after its insertion the abdominal fistula ceased secreting urine, and bid fair to close.

After the removal of the catheter on October 8th no leakage occurred through the abdominal sinus.

On cystoscopic examination October 9th no obstruction was encountered in the right ureter, and, although some retention of urine was demonstrable in the kidney, it was much less in amount. The urine was practically clear, save for an occasional pus-cell. The pelvis of the kidney was irrigated with silver nitrate. The abdominal sinus was evidently closing.

From now on the abdominal sinus remained closed, and the patient was discharged on October 15th, the wound healed, the function of the right kidney having been found actively functionating, and the normal patency of the ureter having been established.

On October 23d the patient returned to the office for another cystoscopic examination. No retention of urine was demonstrable in the right kidney, the urine being practically clear.

Summary.—The vitality and healing power of the ureter are amply shown in this case, where even in an inflammatory field the ureteral continuity had been re-established after resection. At any rate it has been demonstrated that not only should an attempt at ureteral anastomosis be made in such cases, but that the ureteral retention catheter is of great value in causing closure of a ureteral urinary fistula.

(*d*) **Perforation of the Ureter (with Abscess).**—Although this is not a common occurrence, several cases have come to my notice during the last ten years. Here is a man in whom perforation of the ureter with ureteral abscess is not an unlikely diagnosis, since he has just had an acute attack of lumbar pain, fever and chills, marked rigidity and tenderness, and has an obstruction which corresponds in the *x*-ray plate to a stone about 2 inches below the renal pelvis. A differential diagnosis between acute pyelonephritis, multiple abscess, retention of pus in the kidney, suppurative infarction giving rise to temperature, and some or none of these lesions associated with periureteral abscess cannot be made. It is interesting, however, to note that in spite of spontaneous rupture of the ureter healing can take place without suture, but with merely the removal of the offending calculus and drainage of the infected kidney.

Bilateral Lithiasis with Bilateral Renal Infection; Ureteral Blockage by Stone; Periureteral Abscess; Perforation of the Ureter; Nephrotomy; Removal of Calculus; Decapsulation and Recovery.—The patient I am showing you today (A. A.) has had a long history of trouble in both kidneys due to calculi of the phosphatic variety and infection. He has passed stones from both kidneys. He has been kept under observation from May

24, 1919 until today, November 25, 1919. During this time calculi were removed from the bladder through the operating cystoscope, some were crushed; this right kidney was drained through the ureteral catheter on two occasions because of retained purulent urine, these manipulations having given him immediate relief. About five months ago he still had two stones in the right kidney; he had one stone in the right kidney about $\frac{5}{16}$ inch in diameter lying in the lower portion of the pelvis.

It is this stone that is now giving him trouble.

For several days, particularly for the last two or three days, he has had intense ache in the right lumbar region, chills, fever, exquisite tenderness in the region of the back and the kidney, and frequent urination. He feels so sick that he seeks relief.

Cystoscopy shows an obstruction at 25 cm. in the right ureter, and this cannot be overcome; no urine can be obtained from the right kidney.

Conclusions.—We must diagnosticate impaction of the ureter calculus in the upper ureter, $1\frac{1}{2}$ to 2 inches from the kidney, and this assumption is confirmed by the *x*-ray examination.

Operation. Removal of the Ureteral Stone, Nephrotomy, Decapsulation, Drainage.—I am cutting through the perinephritic tissues which you see are enormously increased in thickness; the part is edematous; contains exudate; and the fluid is so large in amount that it is possibly urinous? I am now attempting to feel the calculus at the site indicated by cystoscopy and *x*-ray, and find a large exudate adherent to the posterior abdominal wall. As I separate the inflammatory tissue about this exudate you see this sudden escape of about 1 ounce of thick pus, indicating the existence of a periureteral abscess, due to perforation of the ureter. Here is the stone which has caused the trouble.

I must not be content with this procedure alone, but the kidney must be drained, since it is badly infected, and I am, therefore, making a small nephrotomy opening for the insertion of a tube drain. Decapsulation too must be done, since minute abscesses will escape observation and restitution of the kidney cortex after stripping of the capsule will take place more readily and with more certainty.

The region of the perforated ureter is drained with a rubber-dam and a small tube.

The kidney incision is drained in the manner found best for infected cases.,

Subsequent Course.—This patient made an uneventful recovery.

A subsequent cystoscopy in 1920 and 1921 demonstrated that complete restitution of the ureter had taken place in spite of the fact that no suture had been done, and in spite of the large hole in the ureter which the perforation had occasioned.

V. POTENTIAL PERFORATIONS

(*a*) **Potential Perforations of the Kidney.**—I shall merely mention some of the lesions you may meet in your operative work as follows:

1. Closed cortical leaks in hydro- or pyonephrotic kidneys, or acutely distended kidneys with ureteral or ureteropelvic blockage. In such you may find urine and pus in the perirenal tissues, but the opening has become sealed off (Figs. 179, 180).
2. Potential leaks, so that the separation of the perirenal adhesions establishes a communication with the renal pelvis (Figs. 179, 180). Infarctions of suppurative or ischemic variety occasionally belong here.
3. Actual subcapsular perforation with subcapsular accumulations of fluid (Figs. 181, 182).

(*b*) **Potential Perforation of the Pelvis with Ureteral Stricture.**—We speak of potential perforations of the pelvis as being those which we are able to discover by operative exposure during the period preceding actual rupture, and before extravasation of urine has occurred. That such a stage exists quite a number of clinical examples have taught me.

These potential perforations are defects in the pelvis that have been covered or sealed off by protective peripelvic inflammatory tissues. Thus, we see them occur with ureteral stricture either in the upper lumbar ureter or in the pelvis. Such may be complicated by calculus or may have been produced by a calculus that had previously passed. Associated with such strictures there is apt to be a chronic non-virulent (sometimes called subacute) pyelonephritis with more or less dilatation of the pelvis. The extrarenal pelvis may become enveloped in a brittle inflammatory envelope, which is a protection in that it makes a sort of pseudosheath that substitutes for the eroded and disintegrated ureteropelvic tissues. So extensive may the destruction of the upper ureter and pelvis be in such cases that considerable resection of both of these structures may become necessary when operative procedures are carried out. That considerable loss of tissue is well sustained, and that plastic reconstruction of the ureteropelvic junction is a surgical procedure attended with success even in the presence of such infection, I shall point out to you in the demonstration of the following most interesting case.

In a previous clinical lecture, a case of resection of a similar lesion in the lower ureter with plastic end-to-end apposition of the ureter, was seen to have had a successful issue. Here, too, a potential perforation of the pelvis with rehabilitation of the upper portion of the urinary conducting system prolonged the viability of a kidney much damaged by a previous operation and inflammation.

Chronic Pyelonephritis; Bilateral Renal Infection; Ulcer of the Bladder; Potential Perforation of the Pelvis of the Right Kidney; Resection of the Pelvis and Upper Ureter with Plastic Reconstruction, with Complete Restitution of the Upper Conducting Mechanism.—This middle-aged woman is one of those bad examples of impairment of function of both kidneys due to the untoward effects of chronic infection and mechanical factors, in which much could have been accomplished by the more timely application of modern urologic methods. You see her here today with both kidneys the seat of a chronic pyelitis, with an ulcer in her bladder, a chronic cystitis, and a stricture in the upper right lumbar ureter.

She says that she has had both kidneys "fixed up" (nephropexy) some eleven years ago; since then has been suffering great kidney pain, particularly in the right side, radiating down into the region of the navel. For the past three years her bladder too has been giving her considerable trouble, with increasing urinary frequency.

Let us pause for a moment to consider the question as to why this woman has had pain since her operation. Although it is difficult to come to accurate conclusions and my theory may not appear to you convincing, nevertheless, let me impress upon you that none too infrequently have nephropexies been done in the past on cases of renal infection, particularly when cystoscopic diagnosis has not been properly applied. It would appear to me more likely that this woman had been suffering from a chronic pyelitis with or without stone, for the lesions, I shall demonstrate to you, would seem to bear me out in this contention.

Having cystoscoped this woman upon one occasion, and having found an obstruction in the right ureter at 20 cm. from the bladder, with, however, an abundant urinary flow containing considerable pus, with purulent urine from the other kidney, and without any putput of indigocarmin from either side during a period of one-half hour's observation, you will doubtlessly be rather averse to the immediate induction of an operative procedure, when you know that both kidneys are not only obstructed but poorly functionating.

Make it a general rule that whenever an obstruction is met in the ureter on one occasion, and the *x*-ray examination—as here—shows no calculus to account for it, and when the surgical indications are not clear, to consider most strongly the advisability of subsequent confirmatory cystoscopic examination.

And so here we will cystoscope again, in fact, if necessary more than once, for confirmatory and further corroborating information. Our second and third cystoscopies demonstrate again this same obstruction in the upper lumbar ureter with a flow of purulent urine when the catheter is tightly wedged against the obstruction. What shall we surmise from these findings? That there is a stricture in the upper lumbar ureter; that the eye of the catheter gets beyond it and empties the pelvis of the kidney which is dilated; that there is a chronic infection of the pelvis, possibly a pyelonephritis; that there is an obstacle to the outflow in the centrifugal sense, *i. e.*, from the kidney downward and outward to the bladder, which is an insufficient barrier to the outflow of urine, and that there is a complete obstruction in the centripetal sense, so that the catheter will not pass into the intrarenal pelvis.

Having determined by cystoscopy that it is the right kidney which is giving the patient the most trouble, that there is a left-sided pyelitis, but that the mechanical obstruction in the right ureter is responsible for many of the patient's symptoms and will doubtless jeopardize the integrity of the corresponding organ, it behooves you to determine whether she will withstand a severe surgical procedure. And, second, you will endeavor to determine, even before taking the knife in hand, as to whether you wish to conserve the kidney or not.

For the determination of the first point, the phenolsulphonephthalein test and the blood chemistry are of value. And so here we find that the total output of phenolsulphonephthalein in two hours is about 44 per cent.; and the blood chemistry shows but a slight increase in urea nitrogen and creatinin. The figures are not high enough to contraindicate operative procedure.

In all cases of pyuria where stone cannot be demonstrated in the *x*-ray we must not fail to exclude tuberculosis, and so here careful search was made with negative findings. Indeed, the culture showed the Bacillus lactis aërogenous capsulatus a not infrequent invader of the urinary tract.

Plastic Repair for Potential Renal Pelvic Perforation.—If you will follow me in my operation on this right kidney, as I go through the scar tissue and the adhesions consequent upon the previous nephropexy, you will see here below, along the inner border of the adherent kidney, a mass of fatty inflammatory tissue reaching to the pole, occupying the lower third of the mesial border (Fig. 186, *A*). As I separate this inflammatory fat to expose the ureter and ureteropelvic junction, it is evident to me that there is an encasement of the pelvis and upper ureter with such dense tissue as to produce a veritable contracting sheath, whose influence must, I surmise, be of significance not only in its mechanical effect upon the ureter and pelvis but also in its protective influence upon the alterations that are going on within.

Do not be surprised, therefore, if I should disclose a tear or a perforation in the ureteropelvic junction as I retract, for it is in this region that I suspect the stricture to lie, and it is here that the renal pelvis may be attenuated, corroded, friable, and perforated. You are not surprised, therefore, that in opeing the ureter, as the last piece of inflammatory fat is gently pulled aside, to note the outflow of retained purulent urine from the kidney.

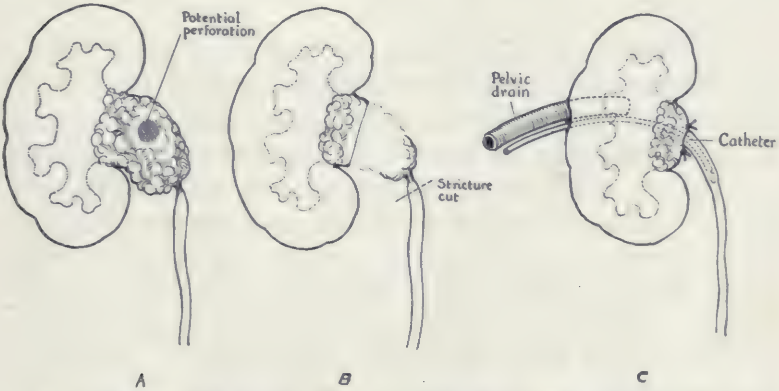

Fig. 186.—Diagrammatic representation of the conditions in this case: *A*, Potential perforation is indicated; central picture (*B*) depicts resection of the degenerated portion of the pelvis and the stricture is indicated; on the right (*C*) pelvic drain inserted, ureter drawn into the pelvis, invaginated, and held by suture; catheter emerging alongside of the pelvic drain acts as a stay for the ureteropelvic anastomosis.

Let us now inspect these tissues. The pelvic mucous membrane is angry red, inflamed, very brittle, the outer coat being evidently destroyed, and it appears to me that the upper ureter will be found to be similarly compromised. I hear the question asked "Why continue stripping off this peripelvic inflammatory tissue, whereby you may jeopardize still more of the tissues?" My answer to this is, "Look back at your history and the findings at cystoscopy." Did we not obtain distinct evidences, on three occasions, of a ureteral stenosis, of retained urine in the kidney? Is not this woman suffering from pain—pain not due to infection alone, but due to a mechanical obstruction, dilatation of the kidney? Was not this kidney demonstrated in the x-ray to be enlarged?

And so it behooves us to explore and relieve this obstruction, if necessary to resect and sacrifice that portion of the canalicular system whose lumen has been coarcted, and whose function as a conducting mechanism is no longer adequate.

And so I shall explore the ureter with a probe, and you see as I enter it the very smallest silver probe cannot enter the lumen of the ureter. This should be sufficient evidence of the correctness of our indications.

Lay open longitudinally this stenosed upper ureter with a fine scissors until we reach the healthy ureter about 1 inch below the perforated pelvis. With these tissues now patent and presenting before you, there can be no doubt in your mind that they can no longer be employed as a reliable wall for the collection of a urinary secretion. We shall, therefore, mobilize the upper ureter to see whether it can be brought upward to meet the pelvis higher up, and now it is evident that this can be accomplished. Let us cut transversely through the healthy portion of the ureter and excise all this friable, inflammatory, unhealthy, ureteropelvic tissue (Fig. 186, *B*). Now we have a hiatus of about 1 inch with very little pelvis to which to sew this ureter. End-to-end suture will be impossible, as you can see, so let us, therefore, make a longitudinal incision into the ureter so as to increase its girth, and draw it upward by a process of invagination into the pelvis. Before doing this, however, let me feel more confident of the result of my plastic operation by making a small opening in the cortex of the kidney and introducing a small catheter (No. 12 Fr.). Now I introduce it into the upper ureter (Fig. 186, *C*), while I draw fine chromic stiches upward and sew them to the pelvis.

As a further safeguard, I insert a small drainage-tube into the infected pelvis of the kidney to the cortex alongside of the small catheter so as to combat the renal infection, and to insure further healing of our plastic operation (Fig. 186, *C*).

After-course.—I am presenting this case to you just fourteen days after operation. The small catheter was removed on the eleventh day, the larger tube on the thirteenth, and today you see that the wound is healed and that there is no leakage, although a small aperture still exists.

Comment.—This patient was examined again on June 17, 1919. Cystoscopy demonstrated that the plastic operation was a success, as there was an absence of obstruction, good flow of urine obtained from the right side, and no evidence of hydronephrosis.

Again on August 4, 1920 cystoscopy showed the absence of stricture.

(*c*) **Potential Perforations of the Renal Pelvis.**—*Pelvic Erosion Due to Stone.*—While occasionally in the neglected case you will be called upon to operate when the stone has migrated through the ureter or pelvis, when a periureteral abscess or extravasation of urine is present, there are milder or so-called subacute cases, characterized by a long period of lumbar ache with pyuria, without severe attacks of high temperature, in which erosion of the pelvic wall by contact with a rough stone, plus the influences of infection, have brought about a potential perforation, protected by periureteral, inflammatory adherent tissues. Such eventuality is most apt to be the complication of the lodgment of the spearhead, triangular, pyramidal rough type of calculus, as I show you in this diagrammatic drawing (Figs. 187, 188). So I may exemplify my thesis in bringing to your notice this interesting case of a woman with a long history of lumbar ache and pyuria.

Fortunately, it is just these cases that demonstrate the viability of the pelvis of the kidney, its great resistance to operative procedure, and its great power of healing and restoration after plastic operation. Conservatism, therefore, and plastic repair of the urinary channel shall be your guiding motives in the treatment of these conditions.

Potential Protected, Renal Pelvic Perforation Due to Calculus; Plastic Closure, Recovery.—This stout woman (L. C.) upon whom I am about to operate (January 14, 1920) has had pyuria and lumbar pain. She has had a cystoscopy performed, and an obstruction was met in the right ureter, 20 cm. above the bladder. Numerous pus-cells were found in the right kidney specimen, and phenolsulphonephthalein altogether absent. The *x*-ray examination showed an indefinite shadow in the region of the pelvis, probably a calculus. Although an obstruction at 20 cm. in an adult is usually below the pelvis (about 2 inches), or the ureteropelvic junction, it is well for you to remember that a short distance such as this does not necessarily rule out the fact that your catheter is impinging against the ureteropelvic junction. It is only by the employment of the shadowgraph catheter that reliable information can be had regarding the exact site of the obstacle. This is true, first, because of the varying size of patients, and second, because of the fact that a prolapsed or ptosed kidney may shorten the distance and the length of the ureter considerably.

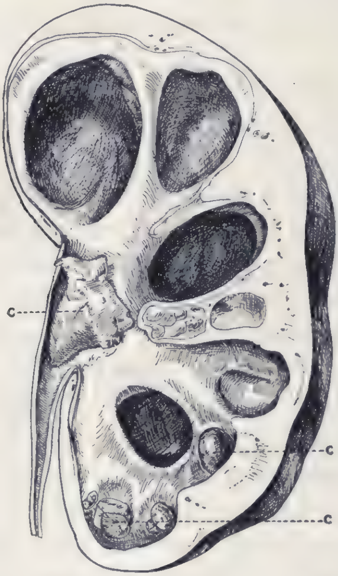

Fig. 187.—Calculus pyonephrosis with typical spear-head calculus blocking the extrarenal pelvis and upper ureter, and the usual site for secondary concretions in the lower pole at *c*.

Plastic Repair of Renal Pelvis.— I am exposing the kidney in the usual fashion, and am encountering old adhesions which are bluntly separated. Now the extrarenal pelvis is in view, and in it a hard mass surrounded by inflammatory fat can be felt.

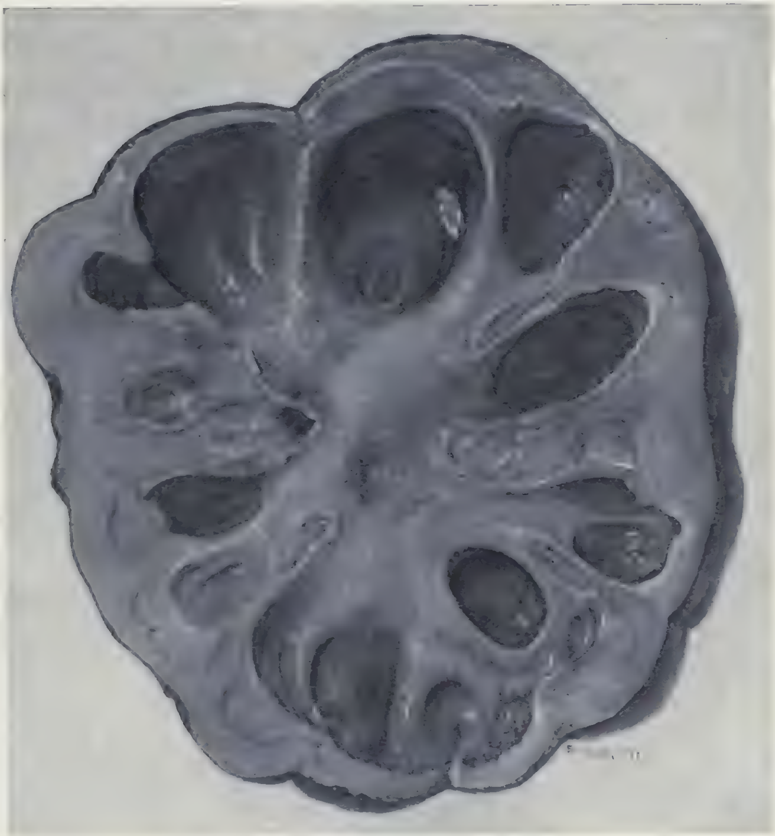

Fig. 188.—Interior view of the above, showing the typical interior of a calculus pyonephrosis; in the center of the pelvis is the site of the ureteropelvic junction; the mucous membrane is swollen, reddened, and ulcerated; in the lower pole, where the collection of calculi was present, there is an erosion of the inner wall of the sac.

Let us pause a moment here to bring to your notice, to emphasize the difficulties that you may encounter in differentiating between the resistance given to the palpating finger by inflammatory fatty masses and calculus. In truth, you will often be disappointed at your seeming inability to differentiate the two; and it may be necessary to separate much inflammatory fat about a renal pelvis before your effects at palpation will be of diagnostic value.

If you look at the pelvis that is presented to you now, you will see that its normal markings are altogether absent, an irregular mass of lobulated fat and inflammatory adhesions binding the upper ureter to the lower pole of the kidney, the fatty lobulations passing over the kidney and causing an apparent angulation just above the site of the ureteropelvic junction (Figs. 189, 190). At the mesial wall of the pelvis above the ureteropelvic junction a hard body projects; and it is here that care must be exercised lest a large tear is produced in my exposure of the pelvis. As the adhesions are separated a pointed part of the calculus all but emerges through the pelvic wall (Fig. 191). Now I am

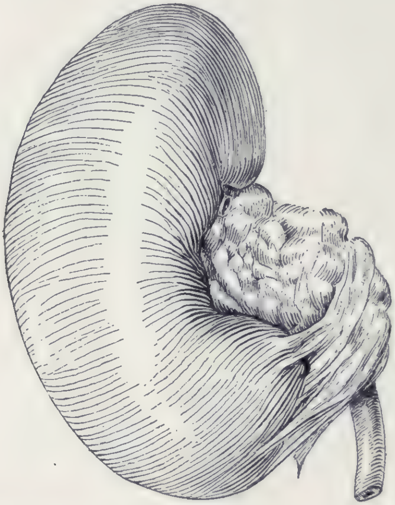

Fig. 189.—External view in the case described where marked peripyelitis is represented by inflammatory fat surrounding the pelvis, with bands of adhesions about the ureteropelvic junction, concealing the potential perforation at the kinked portion of the ureteropelvic junction.

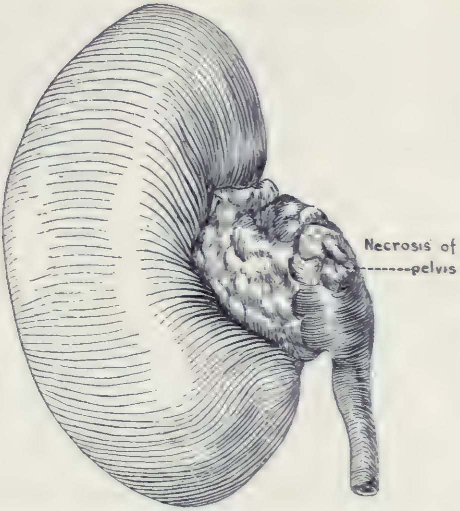

Fig. 190.—Site of necrosis of the pelvis after the removal of some of the adhesions.

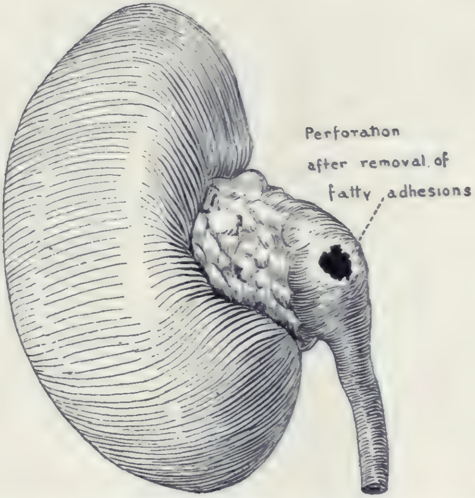

Fig. 191.—Demonstrates the ragged opening in the pelvis with prong of the calculus jutting through the pelvis.

lifting up the ureter, which is thickened, red, swollen, and dilated, and a sharp prong of the stone penetrates the adhesions covering a potential perforation, and there is an escape of some bloody urine. I am now enlarging the opening in the kidney so as to extract the calculus, which is delivered easily and appears to measure about $\frac{3}{4}$ inch in diameter. Because of the dilatation of the pelvis my finger can be easily introduced to find concretions in the lower pole. Because of the evident infection a buttonhole nephrotomy near the lower pole will be made. This is now carried out without hemorrhage, the concretions are removed, and drainage will take place through the nephrotomy opening rather than through the pelvis.

Closure of the Renal Pelvis.—When the tissues in the pelvis are as friable as here you must resort to the inclusion in your fine chromic gut sutures not only of the perirenal tissues, but at times also of the capsule of the kidney, near the hilus. This gives a good support. You may also draw the ureter upward somewhat, passing a stitch through a healthy portion and anchoring it higher up; and thereby broaden a narrow compressed pelvis in typical plastic fashion.

To demonstrate that the ureteropelvic junction has not been infringed upon by my sutures I am passing this long probe through the cortex into the pelvis, and down into the ureter. The suture line in the pelvis need not be drained, but a piece of rubber-dam will be placed down to the region in the immediate proximity of the pelvis, while a small rubber tube will remain in the buttonhole nephrotomy for about six or eight days.

Future Course.—This patient made an uneventful recovery. There was no urinary leakage from the extrarenal pelvis, drainage being altogether through the nephrotomy tube; the wound healing by primary union.

A subsequent cystoscopy demonstrated that the patency of the ureter had been re-established.

CLINIC OF DR. WALTON MARTIN

ST. LUKE'S HOSPITAL

TUBERCULOSIS OF THE LYMPHATIC VESSELS OF THE LEG AND OF THE SECOND METACARPAL BONE. SECONDARY ELEPHANTIASIS

Clinical History and Previous Treatment: First Operation, Amputation of Thigh; Second Operation, Excision of Lower Third of Metacarpal. Comments. Prognosis.

THE patient, a male Italian, is seventeen years old. When four years old a small soft swelling was noticed near the base of the second toe of the right foot. This was opened. The incision did not heal; it continued to discharge small amounts of cheesy, purulent material. In the course of the next ten years similar swellings, following a similar course, appeared between each of the toes of the foot. The ankle gradually became swollen, and about three years ago the leg began to enlarge. A row of soft nodules formed, softened, burst through the skin or were opened on the dorsum of the foot, on the inner side of the ankle, and in a number of places along the leg, and finally in the popliteal fossa. From time to time the leg and foot became much swollen and red. During these attacks he had fever, lost his appetite, and felt sick. The discharge from his leg has varied; at times it is semipurulent, at other times it is very thin and profuse.

I first saw him two years ago. He was brought to me by one of the workers in the Social Service. He had been going about from clinic to clinic having softened nodules opened and indolent sinuses cureted. The diagnosis had usually been, I believe, chronic osteomyelitis.

The examination I made at that time was negative except for the right leg; no lesion of the lungs, bones, or joints was detected. The inguinal lymph-glands were slightly enlarged; several could be felt about 1 cm. in their longest diameter. The leg from the knee down (Figs. 192, 193) was greatly enlarged. The dorsum of the foot and ankle was swollen and cushion-like.

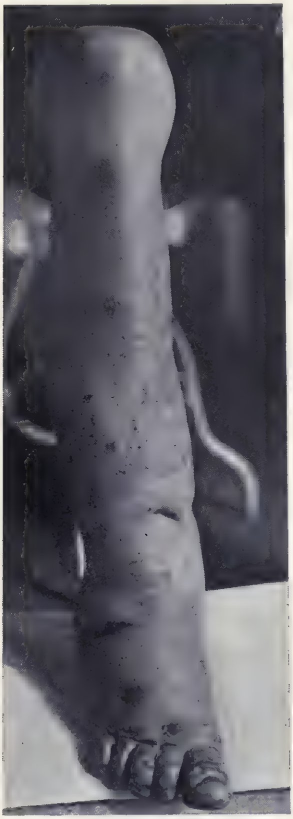

Fig. 192.—Anterior aspect of leg.

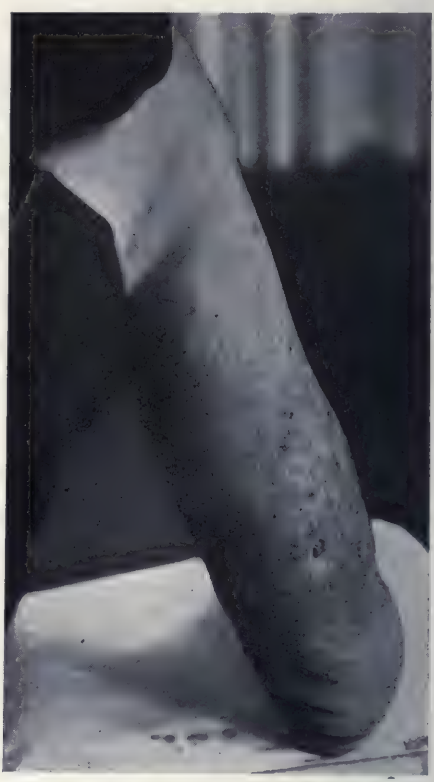

Fig. 193.—Posterior aspect of leg.

The swelling did not pit on pressure; it was rather firm and elastic. There were a number of small ulcerating areas between the toes, on the dorsum of the foot, and along the back of the leg; and there was a sinus in the middle of the popliteal fossa. If you examined closely these ulcerating areas you saw that they had undermined livid edges, and that the base was formed by watery, boggy granulations; a thin, cheesy pus was oozing from some, on others the secretion had dried into a brownish-yellow crust. On lifting up one of these crusts a thicker secretion could be seen exuding from the ulcerating surface. The knee-joint movement was free up to nearly complete extension, then there was a somewhat yielding limitation of motion. He had been holding his leg slightly flexed ever since the opening of the sinus in the popliteal fossa.

A probe passed gently into any one of these granulating areas demonstrated not only the overhanging skin borders, but found its way readily into a long sinus, extending apparently beneath the skin. I had *x*-ray plates made of the foot, leg, and thigh. They showed no lesion of the bones (Fig. 194).

The appearance of the small ulcerations and broken-down nodules, their curious linear arrangement in the long axis of the leg, the fact that the probe passed in each instance subcutaneously—not into the deeper tissues—and the obvious interference with the lymphatics making the elephantiasis-like swelling of the leg, made me think that the young man was suffering from a very rare condition—tuberculous lymphangeitis. I had once seen a patient with a similar lesion on the arm, and was familiar with the description and plates given by Jordan and referred to in Lexer's General Surgery and in Hildebrand's revision of Koenig's Surgery.

I had a small piece removed from the margin of one of the ulcers. When examined under the microscope it showed the typical lesion of tuberculosis. The ulceration about the toes seemed to me the starting-point of the attacks of secondary infection, so I advised and carried out amputation of four toes. I then laid open several of the subcutaneous tracts. To my surprise, they were far more extensive than I had supposed, and communicated with one another. A probe could be passed readily from the sinus in the back of the leg and made to emerge from the sinus in the popliteal fossa, fully 5 inches away. They were lined with flabby, watery granulations.

The amputation wounds healed and the skin over the sinuses healed, but, obviously, a far more extensive extirpation was necessary.

About a month ago, however, he began complaining of his right hand, in the region of the second metacarpal. An *x*-ray plate showed an obvious lesion. I then advised amputation of the thigh, as he evidently had a blood-stream infection and was beginning to have multiple foci. He, however, refused at first, but has finally consented on account of his increasing disability.

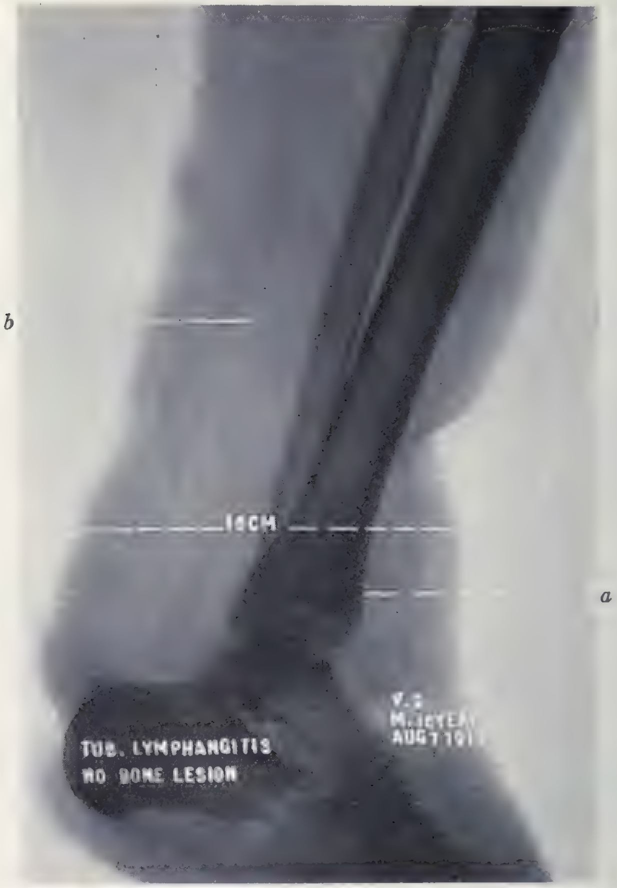

Fig. 194.—*x*-Ray of leg to demonstrate: (*a*) Normal bone; (*b*) thickened soft parts.

As you can see, he now has a sinus over the head of the second metacarpal, and a probe passes into a cavity in the bone. This morning I am going to amputate his thigh. When the stump has healed I am going to resect the second metacarpal. Both operations must be done in a contaminated field. It is obviously difficult to sterilize the skin of the leg, and I must leave as long a thigh stump as possible. This will carry the skin incision near this uppermost sinus (a new one has formed just above the knee). It is for this reason I have decided to do the operations one at a time.

First operation, June 10, 1920: I am using nitrous oxid gas and oxygen as an anesthetic. The foot and leg are bandaged with sterilized material and the thigh is painted with iodin, including the mouth of the last sinus. I use the method of Lister for insuring a bloodless field—I have the leg elevated for three minutes. When the tissues become blanched from spasm of the arteries I apply a constricting rubber bandage. Obviously, it would be undesirable to apply an Esmarch from the foot up; tubercular bacilli from the infected area might readily be forced into the circulation. I shall use the flap method, making my longer flap on the side away from the sinus, thus gaining as long a stump as possible. You see, as I cut through the skin, that there is almost no bleeding and that the derma and subcutaneous tissue at this point are somewhat thickened. As I make my short postero-internal flap I am passing through pathologic material. I have opened a tunnel lined with flabby granulations. The process in the lymphatics has extended higher than I supposed. I will, therefore, change my incision and make my amputation 3 inches higher. Now I am going through tissue that is not obviously altered. There is nothing abnormal to be noticed as I cut through the muscles or saw through the bone. I am severing the periosteum flush with the cut surface of the bone. The vessels are ligated; the large nerves are pulled down, excised, and the trunks injected with absolute alcohol. The constricting bandage is removed; the moderate bleeding from the muscle branches is stopped. The muscles are brought together in the usual way with interrupted catgut sutures and the skin with interrupted silk and horsehair. I am taking great pains to get exact skin apposition. I introduce two rubber tubes in the angle of the wound and apply heavy gauze dressing.

Second operation, September 21, 1920: The patient has gained 15 pounds. The amputated leg showed linear tracts of tuberculosis extending as tunnels in the subcutaneous tissues. He had almost no reaction following his amputation and astonishingly little pain and discomfort. The stump has healed soundly except for two small areas about the size of the head of a pin, along the line of incision, which are covered with crust. On removing these crusts a small ulcer is found under each. They look like small tuberculous lesions. They are very superficial, however. There is no sinus, and I believe they will readily heal after cauterization.

I am again using nitrous oxid gas and oxygen anesthesia. I do not now need a bloodless field. I am going to cut through the sound portion of the second metacarpal and remove the distal portion containing the tuberculous focus. I make my incision circumscribing the mouth of the sinus and then extend it distally along the line of the metacarpal. With the knife I cut away the soft parts just external to the periosteal covering. When I have established the right plane, I insert a blunt periosteal elevator beneath the sound proximal portion of the metacarpal about $\frac{1}{2}$ inch from the diseased portion, introduce a Gigli saw, and divide the bone. I now lift up the bone distally to the division with forceps, and then with a sharp knife sever the tissues about the bone as they are put under tension. When I reach the joint I divide the ligaments and remove the infected bone without having cut through any diseased tissue (Fig. 195).

I put a small amount of iodoform powder into the cavity after the removal of the bone. This dead space will fill up with blood, and blood—although when first shed it is bactericidal—soon becomes an excellent medium for the growth of microorganisms. The iodoform will not kill bacteria, but in the presence of blood-clot will keep on liberating iodin—as you can easily prove by testing the urine tomorrow—and will thus make a less satisfactory pabulum for bacterial growth. I once poisoned a man by introducing a considerable quantity of iodoform after resecting a hip. He had delirium, high fever, and a very rapid pulse. The clinical picture resembled hyperthyroidism. He recovered, but since then I have been careful not to introduce very large amounts.

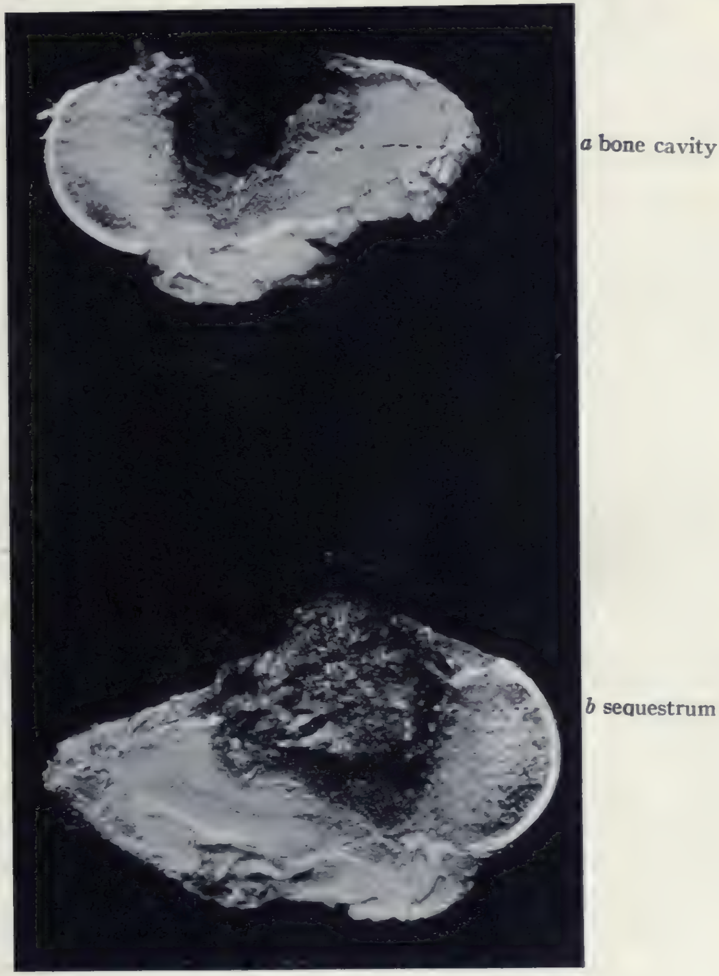

Fig. 195.—Resected end of metacarpal divided longitudinally after removal to demonstrate: (*a*) Bone cavity; (*b*) bone cavity with sequestrum.

I shall close the wound with a few interrupted horsehair stitches. I prefer not to drain after excision of a tuberculous lesion, if possible. The wounds seem to heal better and with less tendency to a persistent secondary infection if a track is not established into the deeper tissues. I put the hand up in a light plaster-of-Paris dressing. I shall watch the temperature. If there is temperature or much pain I shall remove the plaster and take out the stitches.

Comments.—Although tuberculosis of the lymph-glands is so common, and although tuberculosis of the lymphatics in the lung and in the mesentery is well known, this lesion is a very unusual one. Possibly it is due to some special way in which inoculation occurs; possibly, to a secondary infection and consequent obliteration of the lymph-vessels which made the walls vulnerable and easily affected.

It is interesting that during fourteen years the lesion was confined to one extremity; then it finally reached the blood-stream and caused a metastatic lesion. Did the preliminary operation and incision cause this? The patient could have been readily cured of his disease in the beginning. Simple excision of the original focus or of the early secondary foci would have sufficed. Incision and cureting is a very unsatisfactory method of treatment for local tuberculosis. Complete excision is very satisfactory. When the curet is used, the superficial granulations are removed, but the tubercles that lie deeply embedded in the organized connective tissue, making up the outer wall of the lesion, are untouched. Simple incision almost invariably leads to secondary infection and advances rather than retards local disease.

Originally I had hoped to get the leg free enough from secondary infection to be able to excise the entire tuberculous tract with the deep fascia—doing, as it were, a Kondoléon operation and at the same time removing the diseased tissue. The extent of the secondary infection and the metastasis made me abandon this idea.

I believe the prognosis is good. The young man has already gained 15 pounds since his amputation, besides the weight of the leg removed. He looks and feels well.

CLINIC OF DR. FORDYCE B. ST. JOHN

First Surgical Division (Medical Department, Columbia University), Bellevue Hospital

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EMPYEMA

This morning I shall present to you selected cases of empyema from our Follow-up Clinic. These cases have been selected from our empyema series to illustrate, first, problems of diagnoses and treatment and method of meeting these problems; second, the bacteriologic and pathologic findings, with their significance; third, complications as they arise during the course of an empyema; fourth, errors in judgment on our part, with a careful analysis of these errors and unsatisfactory results; and lastly, to emphasize the care in the postoperative treatment which is absolutely essential to consistent success in treating patients with this disease.

Last week you saw in this clinic the operative procedure employed in cases of empyema, and several cases still in the hospital illustrating phases of the immediate postoperative treatment, with emphasis on Carrel-Dakin technic. Today the patients whom you will see have been discharged for from several months to one and a half years. They will be shown with a summary of the history, physical examination, roentgenologic findings, bacteriologic factors, pathology at operation, and finally with a résumé of the course, the condition at time of discharge, and later follow-up visits.

For the last year and a half the series comprises 40 cases. Of these, 9 are cases of abscess of the lung without empyema, 5 are cases of abscess of the lung with empyema, leaving 26 cases of empyema of the acute and chronic type. It is of these cases which I wish to speak today, inasmuch as we will consider abscess of the lung, with and without complications, at another time.

Of the total number of cases of empyema, uncomplicated by abscess of the lung (26), 2 have died, or a mortality of 7.5 per cent.

An analysis of these deaths shows the following: The first case was an acute streptococcus empyema, admitted to the medical service with a temperature of 105° F., pulse 120, and respiration of 36, with a bilateral pneumonitis. He was transferred to the surgical side in a moribund condition, and because of his type of infection, and profound degree of sepsis, we simply aspirated the right pleural cavity and removed 850 c.c. of typical streptococcus seropurulent exudate. He died fourteen hours after his admission, and the postmortem examination revealed, besides the suppurative pleuritis of the right side and an atelectatic lung, an extensive bronchopneumonia of the streptococcus type involving the other lung. There was also a seropurulent pericarditis.

The second case, a woman of thirty-four, was originally admitted to the Department of Laryngology with edema of the larynx as a result of advanced syphilis, which had necessitated a tracheotomy, and upon admission a tracheotomy tube was in place. After strenuous antisyphilitic treatment for six months a streptococcus pneumonia suddenly developed, followed by suppurative pleuritis, and after repeated aspiration, showing Streptococcus hemolyticus in the medical service, she was transferred to us with the tracheotomy tube still being used.

Under local anesthesia a partial ostectomy of the eighth rib, with drainage, was performed, and 1000 c.c. of thin, greenish-yellow, purulent exudate, with flakes of fibrin were removed. She died three days after admission to the surgical service, and I feel that in this instance repeated aspiration would have been wiser for some time longer rather than operative procedure, as her general condition was very poor, her breathing very labored and aggravated by the laryngeal involvement and her degree of sepsis. It is extremely doubtful that her life could have been saved under any condition, but I feel the operation was contraindicated, considering all the circumstances. Unfortunately, permission to perform an autopsy could not be obtained.

Of the remaining cases, 24 in number, 8 are now in the hospital, and 16 have been discharged.

Of these 16 cases, 15 were discharged cured, and 1 was sent to the country as "improved," to remain until such time as a secondary operation would be deemed advisable for closure of a sinus. Although there was no evidence of a dead space, a sinus tract had persisted, and we felt it wise to give him the benefit of several weeks under ideal surroundings before performing the second operation, inasmuch as he had already greatly improved after a decortication and Carrel-Dakin treatment.

He failed to return, and as we have traced him to another hospital, where he was admitted for a revisional operation, we consider him as an unsatisfactory result on our records. He is now in Arizona, and as yet we have been unable to find out his present condition.

Of the 15 remaining cases, all of which were discharged healed, all have been followed:

1 was discharged sixteen months ago.
2 were discharged fourteen months ago.
3 were discharged ten months ago.
5 were discharged nine months ago.
2 were discharged eight months ago.
1 was discharged two months ago.
1 was discharged three weeks ago.

And all have remained well to date.

None of the cases of acute empyema which we have been able to follow from the onset of the disease have become chronic, although several have presented during their postoperative course potentialities of chronicity. This you will find is the experience of most surgeons who are interested in this problem, and for this reason, as Martin brings out in his paper, "The Etiology of Chronic Empyema," it would seem as if, in all probability, there is nothing inherently present in most acute empyemata, which is a prime factor in causing chronicity, but rather in the operative and postoperative treatment of the condition.

A word or two concerning the mortality in this series. It is important to remember that 7.5 per cent. mortality excludes the 5 cases complicated by abscess of the lung. Were these additional cases included our mortality would be 12.8 per cent.

The first case for demonstration is a woman of twenty-seven, married, with one child seven years old, who came to us with the following history:

About four weeks before admission she began suffering with headache, slight cough, pain in her chest, and sore throat. After two or three days, because of prostration, she went to bed and called a physician. Two days later the cough became worse and the patient's sputum became blood tinged. The physician made a diagnosis of pneumonia, and after treating her for ten days, during which time she seemed to become worse, on his advice she was sent to a hospital.

Soon after arriving at the hospital she says that the doctors "tapped her chest on the right side and drew out some pus," and that several days after that she was "operated upon and her right chest drained." That was about ten days before she was transferred to us.

Upon admission here, although feeling distinctly better, she complained of weakness and shortness of breath and presented a discharging sinus. Her general appearance was that of a "poorly developed, very thin and emaciated young white woman, lying quietly in bed, slightly dyspneic, not cyanotic, and apparently acutely ill."

Physical examination of her chest revealed limitation of expansion on her right side, a thoracotomy wound, 7.5 cm. in length, 4 cm. wide over the eighth rib in the posterior axillary line. The surface of the wound presented a greenish, sloughing membrane. Two rubber tubes 1 cm. in diameter were in place in a sinus of about the same size, and the dressings were soaked with thick, greenish pus. The percussion note was tympanitic below the sixth space posteriorly and dulness existed above anteriorly and posteriorly.

Anteriorly, breath sounds were harsh. In the region of the wound breath sounds were markedly diminished, but bronchial in character, and posteriorly, throughout the entire chest, breath sounds were much diminished. No râles heard. Right chest, especially lower portion, was tender to percussion.

The left side presented resonance throughout, with breath sounds somewhat harsh, and a few subcrepitant râles were heard at the base.

Her temperature upon admission was 101° F.; pulse, 110; respiration, 24.

Blood count: 14,200 leukocytes, 81 per cent. polymorphonuclears, 19 per cent. lymphocytes.

Smear and culture from sinus tract showed a short chain streptococcus.

The Roentgen-ray examination, as you will see from this plate, showed these things: The pulmonic fields are of unequal size, the right being larger than the left, the illumination is brilliant throughout most of the right pulmonic field. The costophrenic sinuses are clear, and you will note that the outline of the diaphragm is visible, but that the right dome is somewhat depressed or flattened.

The heart, although normal in outline, is considerably displaced to the left, and the right lung, the outline of which you may see here, is almost completely collapsed. You will note here the resected ends of the rib and the two drainage-tubes *in situ*, directed upward and inward.

Now, with this data before us, what was the situation? Here was a patient, acutely ill, having presumably had pneumonia complicated by empyema, which two weeks before had been drained in the traditional manner at another hospital, and now came here draining profusely. She presented characteristic signs, with an open pneumothorax, and typical "dead space" which was infected, with a right lung markedly collapsed and not expanding.

Obviously, her mediastinum covered with plastic exudate and fibrin was immobilized, and, although very sick, she was in no way the picture of the open pneumothorax case seen early in the streptococcus infections with such marked dyspnea and respiratory effort as a result of a mobile mediastinum plus sepsis. She was, however, septic, although apparently draining well for ten days or more and with no signs of involvement of the opposite side.

It seemed wiser to carefully observe this patient, keep up her nutrition, preserve adequate surgical drainage, and then be guided as to future treatment by her response as shown by local and general conditions. This was done for eighteen days, and, as you will see from the chart, her course was not satisfactory; the temperature varying from 99° F. in the morning to 101° and 102° F. in the evening throughout this period, while her pulse averaged about 100 to 110, and respirations 20 to 24; and all this time the discharge noted at her daily dressing was described as "profuse." Her general condition may have improved slightly. Inspection of this chart alone for those eighteen days should make one feel dissatisfied with the course of this case. An uncomplicated empyema when properly drained at operation, and when that drainage is adequately maintained after operation, and particularly with Carrel-Dakin treatment, should run a relatively afebrile course after the first week or ten days, and, if the temperature is persistently up, as in this case, there exists some definite underlying cause, which should be found and eliminated, if possible.

You will note that in this case Carrel-Dakin treatment had not been instituted as yet, and that the patient had been using "blow bottles" daily with apparently no effect. Because of her course, because of the lack of response to treatment, and in the absence of causes other than the local condition, an infected "dead space" with inadequate drainage seemed the most probable etiologic factor for the persistence of temperature in this case, and an exploration was made under gas-oxygen anesthesia.

The drainage tract was found to be definitely contracted and tortuous, with a side pocket leading from the main cavity which only partially drained. These factors were removed by simply enlarging the tract, making it direct, and establishing adequate drainage of the side pocket. It was necessary to resect 2 or 3 cm. more of the eighth rib on each side to accomplish this. All told, this simple operative procedure took fifteen minutes, after which Dakin tubes were carefully placed *in situ*, and Carrel-Dakin treatment immediately instituted. Her postoperative course is striking. After this simple procedure the temperature rose to 103° F. on the third day, and thereafter came down to normal on the fifth and sixth days, and after one excursion to 101.8° F. on the ninth day came down to normal on the fourteenth day, and remained so until her discharge from the hospital, eight weeks later.

At her visit last week in the Follow-up Clinic, where she was examined, the following note was made: Eleven months postoperative report: Patient has no fever, cough, pain in chest, or dyspnea. Appetite good, strength normal, weight 114 pounds (gain of 22 pounds since operation). Working capacity normal.

Physical Examination.—Patient looks well, good color, eyes clear, well nourished.

Local Examination.—Wound healed, cicatrix freely movable, equal expansion of both sides of chest, percussion note normal on left side, slight dulness from angle of scapula to base on right side posteriorly. Breath sounds normal on left side, somewhat diminished on right side posteriorly from angle of scapula to base.

This is her last *x*-ray plate and, as you see, there is evidence of resection of the eighth rib on the right side in the posterior axillary line, with, however, restitution of the rib. There is no evidence of pneumothorax; there is moderate thickening of the pleura. The pulmonic illumination is otherwise negative. There is no retraction of the heart, and normal diaphragmatic motion was noted on fluoroscopic examination.

This is her condition as you see her today, and so now, almost one year after operation, we will classify her as a good result anatomically, functionally, and economically to date; but we shall, nevertheless, keep her on our active follow-up file for another year.

This case illustrates very well the acute type of empyema adequately drained at the original operation, but which later during the postoperative course developed a very frequently noted and at the same time frequently overlooked condition—inadequate drainage.

This patient at the time of the second operation presented very definitely a "potential" chronic empyema, which undoubtedly would have developed had not adequate drainage been established at that time. Or, in other words, there would have been a gradual transition from an acute type to the chronic type of empyema, which Walton Martin so aptly describes as "having little or no tendency to heal."

The patient I now present, this young man, twenty years old, was brought to the hospital in an ambulance, with the following history: Fourteen days before admission the patient developed cough and pain in the chest, and, although feeling weak and having had chills and fever for twenty-four hours, was still up and about on the streets until he collapsed suddenly, and was carried into a house and later taken home. After remaining in bed for two days he felt better, and so decided to dress and go out again, which he did, but the next day felt "too weak to do anything," and remained in bed. After ten days in bed, upon the advice of friends, a physican was called, who sent him immediately to the hospital in an ambulance. When he arrived here he was acutely ill, with a temperature of 105° F.; pulse rate, 120; respirations, 40; that evening his temperature reached 107° F., and his respirations were extremely labored. He presented signs of a large amount of fluid in his right pleural cavity, with flatness, diminished breath sounds, and voice from the angle of the scapula down, and also fine crepitant râles over the left lower lobe, with fine musical râles over the left upper lobe, anteriorly and posteriorly. The sputum was frothy and mucopurulent.

Aspiration of the right chest revealed thin yellow exudate with a greenish tinge, showing a Gram-positive diplococcus in the smear, and a culture report later of non-hemolytic streptococcus.

Shortly after admission 700 c.c. of exudate were removed from the right pleural cavity by aspiration, and his general condition was somewhat improved. His respiratory effort was distinctly less labored and his increased comfort very noticeable.

Four days after admission his temperature had dropped to 101° F., pulse to 100, respirations to 24, and his general condition had improved. Within the next eight days his chest was aspirated as the exudate reaccumulated in sufficient amounts to indicate its removal, and he steadily improved, until on the tenth day his temperature was normal. Repeated cultures showed a non-hemolytic streptococcus.

Had this patient been operated upon on admission and an open pneumothorax created the result would, I feel, have been fatal, because, not only was he acutely ill and septic, with marked disturbance of normal metabolism, and therefore unable to withstand any additional shock, but with the pneumonic process still active and therefore with limited pulmonary function and need of oxygen, an open pneumothorax before plastic exudate had partially immobilized the mediastinum, and at least partially walled off the process, would have placed an additional burden on respiratory compensation by its marked change in intrapleural pressure relationships.

The physiologic reasons for this have been ably brought out by Graham and Bell in their original article "Open Pneumothorax, Its Relation to the Treatment of Empyema," which we have gone over together in detail, as well as the later articles by Graham, and I shall not review them further this morning. You will also remember that the clinical results as reported by the Empyema Commission during the war demonstrated the striking drop in mortality in these cases as a result of repeated aspiration, rather than early operation. And so in this case, when finally aspiration revealed frank, yellow pus, when his general condition was very much improved, and the active pneumonitis had cleared up, a rib was resected and drainage established with a local anesthetic, Carrel-Dakin treatment carried out, and after a rather long stay in the hospital he was sent to the country with the sinus closed, and today (almost one year after operation) he is, as you see, quite normal, and his follow-up report shows him to be "capable of his usual work," and physical examination reveals negative local findings except for some dulness beneath the site of scar posteriorly on the right side.

The next case, this boy of seventeen, illustrates a typical case of the chronic type of suppurative pleurisy. He was admitted to the hospital presenting a discharging sinus of the left chest of eight months' duration. One year before his admission he said he had influenza complicated by pneumonia and pleurisy of the right side, and that his chest had been "tapped three times." He was in bed about seven weeks, and then was able to be up and about, although very weak until a month later, when he was sent to the country, and while there, although at first he seemed to improve, he never fully regained his strength, complained of dull pain in the left chest, and had a slight cough. After having been away almost six weeks he became acutely ill again, with fever, acute pain in the left chest, and prostration. He was brought to the city, where an operation was performed and "over a quart of pus" removed from his chest. Almost immediately he felt better, and in eight days he was discharged with a rubber drainage-tube in the sinus tract.

From this time on for eight months he was treated by several "private physicians," had been in three or four different dispensaries, and finally his mother dressed his wound herself, removing the rubber tube, cleansing it, and then reinserting it each day. Upon examination here he presented a discharging sinus in the left sixth intercostal space, mammary line, and just below this a granulating wound from which thick, yellowish-white pus was escaping. The entire left chest showed practically no expansion. A culture from the purulent exudate showed a Gram-positive diplococcus, Staphylococcus aureus, and non-hemolytic streptococcus. The Roentgen-ray examination revealed an encysted effusion in the left pleural cavity, the upper level being at the second rib, in the midaxillary region, and extending obliquely downward and inward to the cardiac shadow, which with the trachea was displaced to the right. It further showed marked compression of the left lung. The left dome of the diaphragm could not be determined, and the left costophrenic sinus was obliterated. No evidence of tuberculosis was found clinically or microscopically and the Wassermann reaction was negative.

After a preliminary course of Carrel-Dakin treatment a major thoracotomy was performed, which revealed the following pathology: A cavity with which the two sinuses communicated contained 4 or 5 ounces of thick yellow pus, a relatively small "dead space." Upon further exposure, however, a second cavity was found corresponding to the upper portion of the shadow shown by x-ray, which communicated with the first through a narrow tortuous, intrapleural tract. When this was freely exposed about 6 or 7 ounces of additional pus were evacuated. We could now visualize the general cavity, note the markedly collapsed lung, failing to expand because of a thick organized exudate involving the visceral pleura. There was no diaphragmatic action on that side, and the walls of the cavity presented markedly thickened pleura. The entire cavity was irrigated with Dakin solution, after which eleven Carrel tubes were placed *in situ*, extending well up toward the apex.

Because of the gross infection of the dead space at the time of operation it was deemed wiser to attempt to sterilize the cavity before proceeding with the radical removal of the well-organized exudate involving the visceral pleura over the collapsed lung, especially as there was a very real possibility of expansion of the lung and at least partial obliteration of the "dead space," with the use of sodium hypochlorite solution in a cavity which now was adequately drained.

On the day following operation the patient began to use his bottles for deep inspiration, followed by forceful expiration.

Within two weeks the discharge has become distinctly mucoid in character, and its examination revealed an average of 2 to 3 organisms per field. The patient was up and about, had joined the empyema class on the balcony, where our post-operative cases go through regular setting-up exercises under a leader, with emphasis on chest exercises and deep breathing.

One month after operation, although distinctly improved generally and locally, the capacity of the "dead space" having diminished by one-half (by routine determination of the fluid it would contain), the local condition had become stationary, and fluoroscopic examination revealed a very definite limitation of expansion of the left lung.

And so now, in the presence of a relatively sterile field, with the exudate over the lung markedly diminished by the action of the Dakin solution and with a cavity one-half the size of the original, we operated again and decorticated the lung, making crucial incisions where the membrane was so intimately adherent to the lung that we could not peel it off. The wound was completely closed except at the lower anterior portion, where the Carrel tubes were introduced.

He was out of bed on the sixth day, walking about and exercising on the eighth day with the class, and was discharged one month and five days after the second operation, with his wound healed, having gained 16½ pounds since his admission.

Today as you see him, one year later, he has gained altogether 32 pounds, some of which is due to normal growth, and he is very well. This is his *x*-ray plate taken one week ago. There is evidence of the seventh rib resection, with slight retraction of the soft tissues at this point. You will note that the pulmonic fields are normal and one can detect no fibroid changes. The heart occupies a normal position.

This case illustrates what can be accomplished in a persistent type of chronic empyema by, first, adequate drainage and the proper use of Dakin solution, both as a pre- and postoperative measure; second, the results which can be obtained by conservative operative procedures; third, the great importance of postoperative care and the value of regularly performed exercises, especially those involving respiration, and work about the ward, both of which unquestionably improve the local as well as the general condition.

The next case which I shall present is this little girl, who is now seven years old. About eight months ago she was referred to us for treatment through our Social Service Department. Her mother, who brought her to us, had indeed a long story to tell. For four and a half years the child had been an invalid with a discharging sinus of the right chest. When she was a year and a half old she had pneumonia and was acutely ill; three weeks after the onset of this illness the mother was told that the child had "water on the lung" and should be operated upon, and an ambulance was accordingly summoned and the child removed to a hospital, where an operation was performed and the chest drained. Six weeks later a second operation was performed on the same side, and seven weeks later she was taken home with a sinus of the right chest draining thick white pus.

During the next four and a half years she was treated by several doctors in the community where her parents lived and in many dispensaries, but her condition remained unchanged and the sinus persisted.

Upon her admission here she was a pathetic little figure, emaciated, and undersized. Her thorax was asymmetric, with atrophy of the right pectoral muscles and prominence of the lower sternum. There was slight scoliosis of the spine in the lower thoracic region. Further examination revealed a partially healed scar beneath the right scapula extending forward to the midaxillary region in the sixth intercostal space. At the anterior extremity a sinus persisted about $\frac{1}{2}$ cm in diameter, from which thick green pus escaped. In the right chest breath sounds were harsh just above the scar, with coarse râles; below the scar breath sounds were distant. Percussion of the right side revealed marked dulness over the lower half of the right chest anteriorly and posteriorly. The left chest presented signs of compensatory respiration. The terminal phalanges of all the fingers were clubbed and the nails rounded.

Roentgenologic examination at that time demonstrated, as you will see, from the plate which is now illuminated, fusion of the seventh and eighth ribs, diminution in the illumination in the lower and inner half of the right pulmonic field, the right costophrenic sinus obliterated; the left normal. There is increased density of the shadow of the right hilum and apparently incomplete collapse of the right lower lobe. The left diaphragmatic outline is normal; the right is not visible in the outer half. I call your attention now to this small opaque quadrilateral shadow over the inner portion of the right diaphragmatic dome. It is approximately 1 by 3 cm. in size, with a very definite outline. It suggests very strongly a foreign body of some sort, and we know that the most common foreign bodies found in these cases are portions of rubber drainage-tubes or pieces of gauze, and that is just what this proved to be at operation, about 2 cm. of ordinary rubber tubing, which seemed to be partially calcified.

Repeated cultures from the sinus showed Staphylococcus aureus, and at no time tubercle bacilli, and sections removed from the tract itself showed chronic inflammatory tissue with no evidence of tuberculosis. The Wassermann reaction was negative, the urine showing a faint trace of albumin, but otherwise negative. The sinus tract admitted a Dakin tube with difficulty for about 15 cm. and was apparently tortuous.

Let us analyze the problem as it presented itself to us. Apparently we had for consideration a partially collapsed lung outside of which was a chronic empyema cavity which was non-tubercular, grossly infected with rigid, non-yielding walls. Drainage was obviously inadequate and, in addition, the cavity probably contained a foreign body. Because of these factors it was deemed wiser to carefully explore the cavity, making certain of adequate drainage, and remove the foreign body without the preliminary course of Carrel-Dakin treatment, because of the markedly contracted and tortuous sinus tract which would have made efficient sterilization of the cavity difficult. This was done, and the following pathologic conditions were found to be present: The tract led to a small circular bony orifice at the site of fusion of the seventh and eighth ribs, which was less than ½ cm. in diameter. Upon removal of portions of the fused ribs the dead space could be visualized; it was conical in shape, the floor formed by the diaphragm, the outer wall by thickened parietal pleura, the mesial wall by the thick membrane over the partially collapsed lung, and the roof formed by dense connective-tissue adhesions extending from the collapsed lung to the lateral chest wall. The cavity contained 3 ounces of residual pus and its capacity was estimated at about 10 ounces. There was no expansion of the involved lung and no diaphragmatic action on that side. The foreign body was found and removed and adequate drainage established, the old sinus tracts being completely excised. Carrel-Dakin treatment was instituted.

Following the operation her general condition improved greatly, but despite the general improvement after two months the local sinus persisted. Repeated fluoroscopic examinations and measurements showed some gain in obliteration of the "dead space" and lung expansion, but adequate sterilization with Dakin solution could not be accomplished despite rigid attention to skin surrounding the wound and careful dressing technic. There apparently existed some reason for the persistent reinfection, and finally we were able to demonstrate infection of the adjacent rib ends with a small sequestrum present.

This was removed and the necrotic rib ends excised. It was with great difficulty that the drainage tract could be maintained owing to the very marked tendency to contract, and it was not until a final operation, fully re-exposing the entire "dead space" and leaving the wound open and freely accessible to the Dakin solution, that we were able to sterilize it. Eight days after the last operation multiple smears from various portions of the cavity showed four organisms in two microscopic fields, and a week later none could be found in 50 fields, and cultures were negative. We were able to maintain this condition until the entire cavity became obliterated and a short sinus alone remained, about 4 by 2 cm. This was injected with bismuth paste, and the wound was completely healed three weeks later and has remained so to date.

Her last Roentgen-ray examination, the plate which you see here, shows the evidence of partial resection of the seventh, eighth, and ninth ribs, a small amount of bismuth in the chest wall in what was previously the sinus tract. There is no evidence of effusion, but throughout the lower right chest is evidence of very definite pleural thickening. Fluoroscopically, the right lung shows good expansion, and this is borne out by physical examination. It is important to keep this patient under observation, as it is too early to be sure of the final result. She is now staying in the country and has gained altogether, since admission nine months ago, about 15 pounds, weighing today 60 pounds.

I have shown this case because it illustrates so well the etiologic factors commonly encountered in these very persistent cases of long duration.

A word or two about postoperative care: We feel that the postoperative care is of extreme importance in cases of either acute or chronic empyema, and that unless one is constantly on the watch conditions develop which later lead to prolonged chronic infection, and with this in mind we have so organized our after-care that each week, on a chart made for that purpose, we graphically indicate the following things: (1) Food intake in calories, (2) weight, (3) capacity of cavity, (4) bacterial result of smears and cultures, and as soon as a spirometer practical for ward work can be obtained we intend including on the chart the vital capacity, also checked up weekly. In addition to this a résumé of the general condition, temperature, pulse and respiration, and fluoroscopic examination, is made at the same time, and we consider the frequent fluoroscopic examinations of great importance.

In this clinic our operative technic has been simplified in all cases in which a local anesthetic is used by the employment of a syringe with a needle bent in its distal portion at an angle of about 60 degrees for infiltration of the intercostal nerve in the subcostal groove. Such needles as oral surgeons frequently use serve very well.

Our results in chronic empyema have been improved by the following measures:

1. Consistent use of Dakin's solution, with rigid technic as to preoperative as well as postoperative treatment, whenever it can be efficiently carried out in any given case, with emphasis on its postural application.

2. Major thoracotomy so performed, when indicated, as to familiarize the operator by visualization with the actual pathologic conditions which exist. Credit for this type of exposure largely belongs to Lilienthal, in that he early recognized its advantages and widely advocated its use.

3. A graphic chart on which are indicated weekly reports of the important postoperative factors of which I have already spoken.

4. Development of a class for setting-up exercises among the convalescent patients, with also work in the occupational therapy department.

5. Keeping all patients under our immediate care until the sinus is actually closed.

In the surgical treatment of these cases it is of prime importance, as so well expressed by Hedblom in a very comprehensive article on Chronic Empyema reported from the Mayo Clinic recently, to keep before us "the fundamental principles of all good surgery—first the life of the patient; second, the preservation of function as far as possible, and third, the shortening of convalescence."

Finally, the choice of treatment can only intelligently be made by a knowledge of the etiologic factors and pathology in each individual case, and then only can the problem be solved by removing the causes of "the persistent collection of pus in the pleural cavity with little or no tendency to heal."

CLINIC OF DR. CHARLES GORDON HEYD

New York Post-Graduate Hospital

DUODENAL ULCER; PERFORATION; ADHESIONS TO GALL-BLADDER; POSTERIOR GASTRO-ENTEROSTOMY

Duodenal Ulcer: Frequency of Dyspepsia from Reflex Disturbance. Relative Infrequency of Pure Neurosis of the Stomach: Regularity of Symptomatology of Gastroduodenal Ulceration. Specific Characters of Duodenal Ulcer: Hunger Pain, Night Pain. Malignant Degeneration of Gastric Ulcer: Carcinoma of Stomach. Treatment of Ulcer: Technic of Posterior Gastro-enterostomy.

History.—The patient I am presenting this morning is a man forty-two years of age, married, a tailor by occupation. His complaint for the past three years has been pain in the epigastric region. His family history is unimportant and his past history is significant only in the fact that he had typhoid fever twenty years ago. His present illness began three years ago with pain of a cramplike character in the epigastric region. This pain occasionally radiated to the left side of the abdomen and rarely to the shoulder or directly through to the back. The pain came on, as a rule, about two to two and a half hours after meals, and during the first year was always relieved by the ingestion of food. During this period there was never any vomiting nor was any blood observed in the stool. During the second year of the patient's complaint his pain became more intense, was characteristically present two or two and a half hours after meals, and he began to notice that he was awakened at night, usually after 12 o'clock, by the onset of pain. The patient discovered that the pain was relieved by eating and that sodium bicarbonate almost instantly allayed its intensity. During the last year the patient has had attacks of vomiting at irregular intervals and his pain has become more constant, being most intense two or two and a half hours after meals, but lasting almost continuously throughout the day. During the past four weeks the pain has become more severe and at the present time bears no relationship to meals. The pain is neither relieved nor made worse by the ingestion of food. Two weeks ago patient complained of marked gaseous eructations, but without nausea. The patient has never seen any blood in the vomitus or in the stools, nor has he ever been jaundiced. His weight has fluctuated, but without any permanent loss.

Discussion.—In diseases of the right upper quadrant the correct interpretation of a properly taken history is of the utmost importance in arriving at a diagnosis. Moynihan a number of years ago stated that the diagnosis of duodenal ulcer could be made from the history, and all the essential elements necessary for the diagnosis of duodenal ulcer are exhibited in this man's history.

Of 100 persons complaining of gastric distress, or what may collectively be called dyspepsia, in only 20 per cent. will the cause of the symptoms be due to organic disease of the stomach. In 40 per cent. the pathologic lesion will be within the abdomen, but remote from the stomach, and in the remaining 40 per cent. the pathologic lesion will reside entirely outside of the abdomen. In the consideration of dyspepsia one must determine whether the dyspepsia may be classified as a regular indigestion or whether it is of an irregular type. The indigestion that is due to organic disease of the stomach is quite uniformly regular in its chronologic evolution.

In order to diagnose a case of gastric or duodenal ulcer from the history it is necessary that the symptomatology represent three important and cardinal facts: (1) the major complaint of the patient must be pain; (2) there should be a time relationship between pain and food ingestion; (3) periodicity—the recurrence of identical symptoms day after day at approximately the same time.

The dyspepsias due to ulcer have a regular sequence of symptoms in 88 per cent. of cases. By that we mean that once the symptomatology has been evolved it repeats itself day after day with almost unvarying precision and with characteristically the same grouping of symptoms. This is true whether the ulcer is situated in the stomach proper, at the pyloric ring, or in the duodenum, and it is this essential regularity in the symptomatology of ulcer that makes its diagnosis possible from a carefully recorded history.

In the analysis of this man's history we find that his first complaint was pain. The pain was cramplike in character, was confined to the epigastrium, and had a definite recurrence, in that it came on at more or less definite periods after the ingestion of food. If the patient had been a very careful observer he would have found that the same articles of diet which would produce or be accompanied by pain two hours after its ingestion would always produce the same symptoms day after day in almost unvarying precision. In the first year of this man's complaint we have the three essential elements of ulcer—pain, food sequence, and periodic return. During the second year the symptomatology varied somewhat with periods of remission and with the introduction of the element of vomiting, and in the third year the previous periodicity in the pain gave way to a pain which now became continuous and constant in character.

Assuming the correctness of the diagnosis of ulcer during the first two years of his complaint, there occurred some pathologic process in his ulcer during the last year whereby the periodic element was lost and a constant pain took its place. This constant pain was not influenced either by the ingestion or abstinence from food, and the two factors that most commonly account for this change are perforation or the development of a malignancy. An ulcer complex that loses its periodic character makes one suspicious of the development of cancer or perforation. This man had typhoid fever twenty years ago. This fact is of interest in affections of the right upper quadrant; a typhoid septicemia is one of the important etiologic factors in disease of the gall-bladder. The patient, however, in the intervening twenty years gives none of the signs significant of an infected gall-bladder, none of the gaseous dyspepsia, the epigastric fulness, the sense of weight or depression, the eructations of gas, or the occasional attacks of vomiting. All these inaugural symptoms of gall-bladder disease are strangely absent.

When an ulcer begins to perforate you have reaction of the adjacent peritoneum with exudation, and you have in greater or lesser degree a localized peritonitis. The moment that this event ensues the pain becomes constant and loses its periodicity by reason of the fact that the exudate that is thrown out to prevent the further progress of the perforation is an inflammatory reaction, and is not affected ordinarily by the ingestion of food. If this man had originally a duodenal ulcer one does not necessarily suspect the onset of malignancy, as the uniform history from every clinic is of the rarity of malignancy ingrafted upon duodenal ulcer. If, however, this history made us suspect gastric ulcer one would be inclined to feel that there was a possibility of malignancy being ingrafted upon a chronic ulcer. This does not seem to be a very pre-eminent suspicion, however, as the man has lost no weight, his digestive functions have remained unimpaired, and, so far as the history is concerned, we are inclined to believe that the man has a chronic duodenal ulcer with perforation and adhesions to the gall-bladder or to the adjacent tissues. We have reached this conclusion entirely from an analysis of the history. It is necessary that we subject this man's complaint to a more thorough test, and pre-eminently in the way of confirmation or denial of our diagnosis will be the utilization of the *x*-ray. Before we ask Dr. Meyer to demonstrate the *x*-ray plates let us consider some of the other data derived from a careful study of this man's condition. Physical examination is practically negative except for a point of tenderness 1 inch to the right and 1 inch above the navel. There is a slight inspiratory spasm upon insinuating the fingers beneath the right costal arch. In every way his physical examination is negative. The pupils react to light and accommodation and the reflexes appear to be normal. I mention this fact particularly, for in a series of tabetics reported by Nuzum and recorded in one of Murphy's Clinics, 97 of the 1000 cases had been operated upon for supposed abdominal condition, and of the 97 operated upon, 19 were operated upon for gastroduodenal ulcer.

Dr. Meyer: "Examination of the *x*-ray plates of this patient shows that peristaltic activity is variable, at times exaggerated, and then at times quiescent. The antrum is distended and at times overactive. Evacuation is irregular and delayed with a medium-sized residue, somewhat crescentic in shape in the midline at the end of six hours. There is evidence of hypersecretion and notwithstanding the delayed gastric evacuation there is a tendency for colonic hypermotility and the duodenum shows a persistent defect. These findings are quite distinctly those of a duodenal ulcer. The pronounced defect along with the shape and size of the residue and, again, because of the lost tone one would surmise that the lesion is an old one, probably calloused, or, on the other hand, there is either a lighting up of an old ulcer or a new ulcer must be suspected on account of the localized tenderness and the evidence of reflex irritability."

The *x*-ray findings are in consonance with our interpretation of the history, and our preoperative diagnosis is that of duodenal ulcer, chronic, probably perforating, with adhesions to the adjacent tissue.

Operation.—The incision is exactly the same as is used for exposure of the gall-bladder. It begins midway between the ensiform cartilage and the costal arch and extends downward and outward and terminates about 1 inch to the right of the navel. By reason of the divarication of the recti muscles above the navel it is unnecessary to divide many of the fibers of the superior rectus muscle. Almost the entire belly of the muscle may be retracted laterally and so allow us to enter the abdomen without interfering with the nerves to the upper rectus muscle.

In performing laparotomy in a clean case one should thoroughly satisfy oneself as to the condition of the entire abdomen. There are ordinarily about six points for exploration: gall-bladder and pyloric zone, the appendix, the sigmoid, palpation of both kidneys, and in women the uterus and adnexa.

We proceed to palpate the sigmoid, the region of the cecum, and usually do a preliminary appendectomy, reserving our main operative work for the condition which constitutes the indication for the surgery. It is well to remember that in 15 per cent. of all laparotomies there are two conditions either one of which offer a surgical indication for a laparotomy. One has only to recall the more than casual association of gall-bladder disease with the fibromatous uterus and the marked incidence of appendicitis with ulcer, and appendicitis with disease of the biliary system.

The normal postmortem rate for disease of the appendix is approximately about 17 per cent. This is based upon the microscopic examinations and the finding of partially or completely obliterated appendices, and it may be stated that out of 100 persons dead of various causes, 17 per cent. will show the unmistakable evidence of disease in the appendix. In appendices removed during the course of operations for gastric and duodenal ulcer the percentage of diseased appendices rises to 54 and 66 per cent. respectively. This is more than a casual relationship, and lends confirmation to the suspicion that the appendix is a source of focal infection and possibly not an infrequent cause in the production of ulcer of the gastroduodenal segment.

It is claimed that disease of the appendix is one of the most frequent causes of gastric hemorrhage, and one recalls a number of cases of pronounced hematemesis where the complete exploration of the abdomen in the hands of the most expert surgeons has failed to reveal any lesions other than in the appendix. Cases have been reported by Moynihan, Deaver, Mayo, and Moschcowitz of almost fatal hemorrhages as the result of disease of the appendix.

Most of the abdominal viscera are closely related to each other by a neuromuscular mechanism, and one may conceive of the stomach, duodenum, biliary tract, pancreas, and appendix as one essential neuromuscular-physiologic system. In this connection one recalls the close relationship between the ileocecal valve and the pyloric ring as pointed out by Barclay.

In gastric surgery probably the two mechanical factors most conducive to good work are absolute hemostasis and ample exposure. By the introduction of the Balfour retractor and wide spreading of the wound we have complete visualization of our field. We first recognize the pylorus by means of the superior and inferior pyloric veins, and we have here a very interesting condition—an adhesive process between the gall-bladder and the duodenum. The adhesions are very dense, firm, and suggest the possibility of a cysticoduodenal fistula. Before separating this dense band of adhesions we find here the unmistakable evidences of a perforating ulcer. The nearby duodenum is highly injected, and encircling the base of the adhesion there is marked stippling or little punctate points of ecchymosis (Fig. 196).

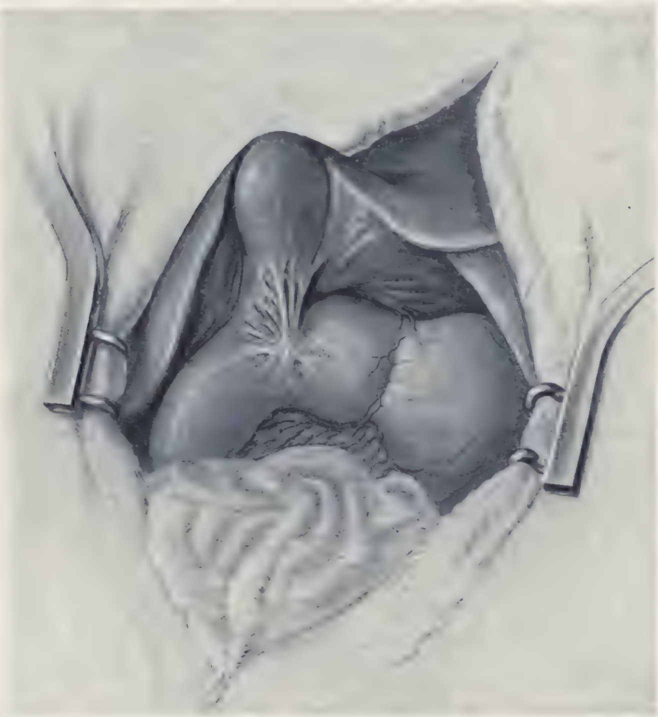

Fig. 196.—Duodenal ulcer showing plastic exudate, stippling, and adhesions to gall-bladder.

There is a plastic exudate on the superior and anterior surfaces of the duodenum which is more or less thickly matted to the adjacent sides of the gall-bladder. The gall-bladder itself does not show any calculi nor is there any marked thickness of the wall except at the point of contact with the duodenum. There is not sufficient change in the gall-bladder to warrant its removal.

We will now proceed to dissect the duodenum from the gall-bladder so as to allow the gall-bladder to ride free without kinking or fixation. Upon separating the adhesions we find the ulcer is situated on the anterosuperior border of the duodenum about 5 cm. from the pylorus and bringing about a relative duodenal stenosis from invasion and cicatrization.

A purse-string suture of No. 2 chromic catgut will be passed around the ulcer for the purpose of inverting the ulcer and more adequately protecting it from possible subsequent perforation. In addition to this procedure we will anchor a portion of the gastrocolic omentum to this portion of the duodenum so as to completely cover this area with a peritonized surface, namely, that derived from the peritoneum of the omentum.

For the cure of the ulcer we will proceed to do a posterior gastro-enterostomy or, more correctly, gastrojejunostomy. The transverse colon with the great omentum is lifted upward and to the left, thereby exposing the under surface of the mesocolon. I wish to draw your attention to this large blood-vessel which makes an arch on the mesocolon and which represents the colica media artery. Great care should be exercised not to injure this vessel, for if it is injured it must, of necessity, be ligated, and this accident carries with it the possibility of gangrene of the transverse colon in at least one-third of all cases. We now locate the first portion of the small intestine by following down the under surface of the mesocolon until we come to the emergence of the jejunum from under the mesocolon opposite the second lumbar vertebra at the so-called angle of Treitz or the duodenojejunal juncture. Occasionally there is a thin film of peritoneum which holds this portion of the jejunum in close apposition to the mesocolon. This is sometimes known as the ligament of Treitz, and if present should be divided in order to make the jejunal loop perfectly free.

The posterior gastro-enterostomy that we are about to perform is sometimes called a no-loop operation. This is not strictly speaking correct, for it is essentially a short loop operation. Some portion of the jejunum must be left free in order to mobilize and approximate it to the stomach. There are in general two types of technic for doing a posterior gastro-enterostomy, depending upon whether one employs the jejunum isoperistalticly or antiperistalticly. If the jejunal loop is drawn from left to right (patient's left to right) then the peristalsis of the small intestine is parallel with the peristalsis of the stomach and is known as an isoperistaltic anastomosis. If, however, the jejunal loop is carried from right to left (patient's right to left) then the peristalsis of the jejunum is opposed to that of the stomach and is known as an antiperistaltic anastomosis (Figs. 201, 202). Functionally, it makes very little difference as to

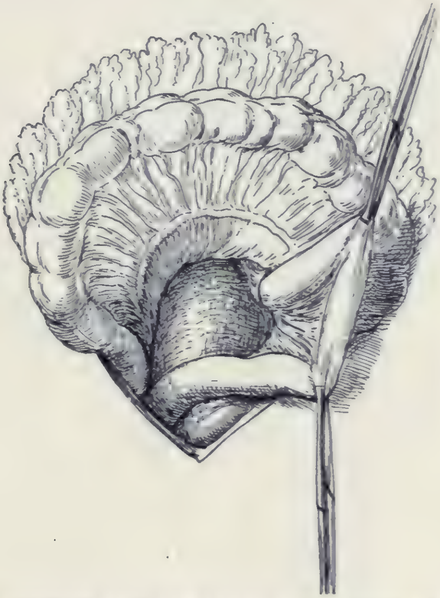

Fig. 197.—Transverse colon lifted up to expose mesocolon with emergence of jejunum at angle of Treitz. Small intestine grasped with two Allis clamps.

whether the loops are approximated iso- or antiperistalticly. In this clinic it has seemed, as a rule, easier to make the anastomosis isoperistaltic (Fig. 201).

The next step is to place two Allis' clamps on the jejunum approximately 3 inches apart. We do not place these Allis' clamps directly on the antimesenteric border of the jejunum, but grasp the bowel about 1 cm. nearer the mesentery on the anterior surface. We do this so that later when we make our incision in the jejunum it will actually correspond to the antimesenteric border of the jejunum. The proximal clamp is placed as near the duodenojejunal angle as will safely allow the bowel to be lifted up and placed in a rubber-covered intestinal clamp and approximated to the stomach (Fig. 197). We now grasp

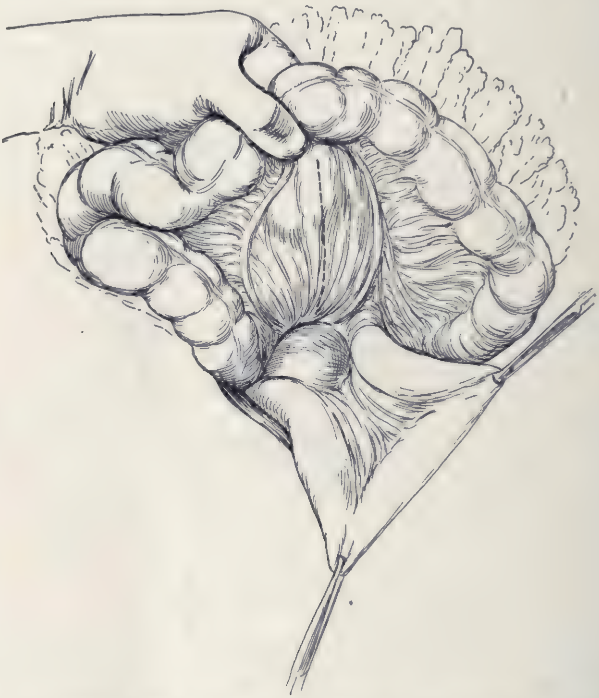

Fig. 198.—Proposed line of incision in mesocolon. Posterior wall of stomach pushed down by first and second finger of left hand.

the transverse colon and omentum between the thumb and first finger of the left hand and pull down toward the lower angle of the wound. This maneuver allows us to place the first and second finger of the left hand on the anterior surface of the stomach, not far removed from the pylorus. We make pressure from above downward on the stomach with our left hand and so force the posterior wall of the stomach into the space beneath

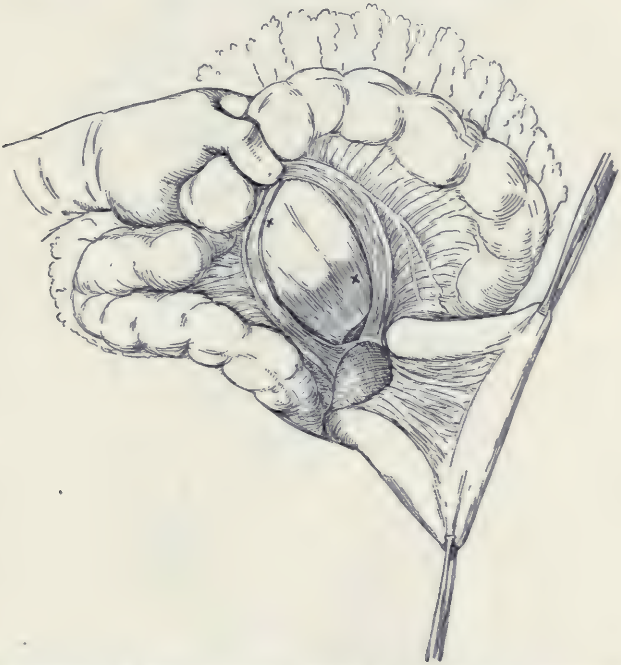

Fig. 199.—Points at which posterior wall of stomach is grasped with Allis' clamps.

the colica media artery. The transverse colon and the colica media artery are lifted up and out of danger by the thumb of the left hand, and we open into the lesser peritoneal cavity by incising the mesocolon below the artery with scissors and blunt dissection (Fig. 198). This aperture is usually made from above downward, and by reason of the pressure exercised by the fingers of the left hand the posterior wall of the stomach readily protrudes through the orifice into the field. We place one Allis clamp at the greater curvature of stomach as it protrudes, and directly below it, about 3 inches apart, a second Allis clamp is applied (Figs. 199, 200). The direction of these clamps on the posterior wall of the stomach with the patient in the upright position approximates a line drawn from the left shoulder to the right hip, and represents the direction of the anastomosis between jejunum and stomach. We now replace the transverse colon and omentum within the abdomen and apply two rubber-protected straight stomach clamps, one to the loop of jejunum and one to the loop of stomach. It is well to have at least 3 inches of stomach and jejunum in the grasp of the clamps, and you will notice that the two clamps are approximated so that the

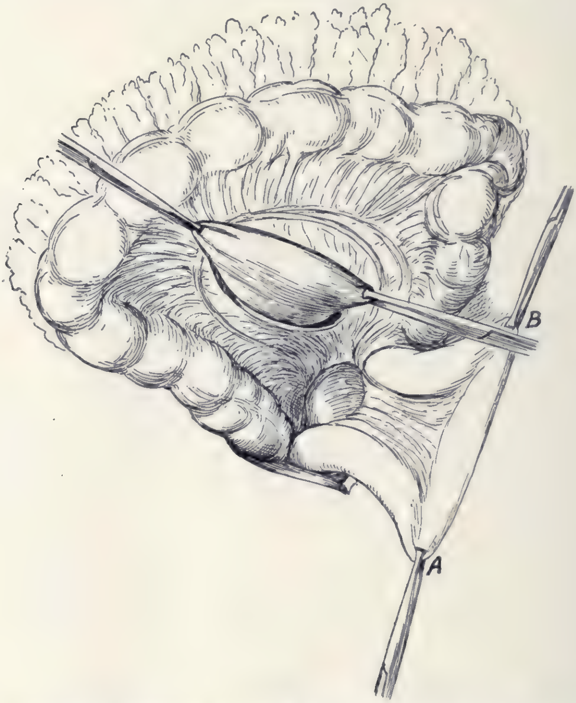

Fig. 200.—Stomach delivered through mesocolon ready for the application of straight rubber-protected intestinal clamps.

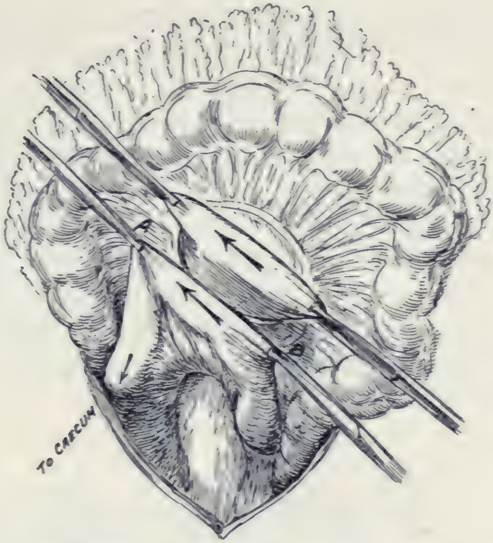

Fig. 201.—The direction of jejunum for isoperistaltic anastomosis

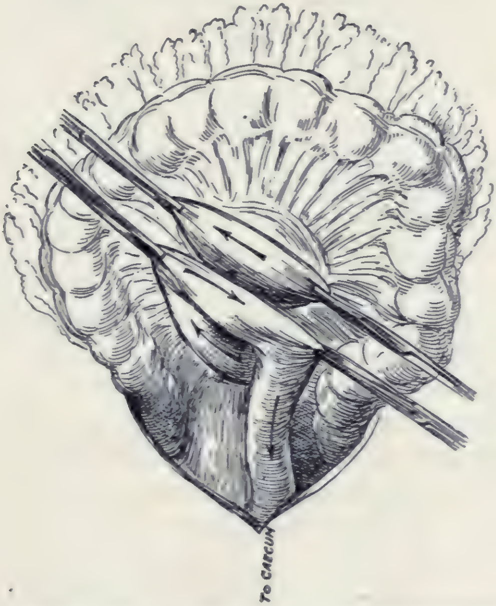

Fig. 202.—The direction of jejunum for antiperistaltic anastomosis.

peristalsis of the jejunum is parallel to the peristalsis of the stomach (Fig. 201). With the superior clamp holding the stomach and the inferior clamp holding the jejunum the entire field is now protected by utilizing five laparotomy pads, one on each side beneath the clamps, one above and below, and the fifth snugly inserted between the stomach and jejunum. We now begin to suture the jejunum to the stomach. With a single Dulox needle swedged on to a No. 1 "tanned extra hard" catgut a continuous Lembert suture is made between stomach and jejunum. This suture line begins at the right-hand side of the patient or nearest to me, and extends at least 3 inches in length, and the last stitch is locked so as to maintain the two loops in close apposition. This first or peritoneal suture approximates the peritoneum of the stomach to the peritoneum of the jejunum throughout the whole length of the proposed anastomosis (Fig. 203).

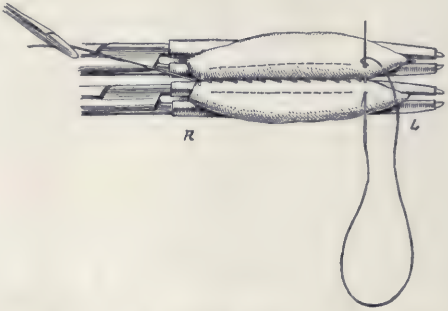

Fig. 203.—The first or peritoneal suture approximating stomach and jejunum. Proposed line of incision for opening loops indicated. (*R.* and *L.* represent patient's right and left side.)

The needle and the remaining portion of this suture is wrapped up in a sterile gauze compress and tucked under one of the laparotomy pads, as it will be required shortly to complete the anterior peritoneal approximation. The stomach and jejunum are now opened and each incision begins $\frac{1}{4}$ inch from the suture line and stops short at each end $\frac{1}{2}$ inch from the beginning and termination of the suture line we have just completed (dotted line Fig. 203). The extruding contents of the stomach and jejunum are carefully mopped up and the field made perfectly dry. We now have two ellipses and four lips, two central—stomach and jejunum—and a superior stomach and an inferior jejunum. We now take a double Dulox needle swedged on to a No. 1 "tanned extra hard" catgut for the inner suture row of the anastomosis. The central lips of stomach and jejunum are lifted up by an Allis clamp at the extreme left (patient's left) of the bowel incision. We begin the inner suture row by tying a knot at the angle nearest to me (patient's right) at about one-third the distance from the first needle of the Dulox double suture. By dividing this suture into three portions we keep one-third wrapped in a sterile compress for later use, while the longer two-thirds is used to entirely encircle the opening between stomach and jejunum and eventually terminate where it began. With the longer two-thirds suture we proceed from the patient's right to left and make a continuous lock-stitch traversing the entire thickness of both jejunum and stomach (Fig. 204). When we approach the opposite end we exercise particular care in placing the so-called angle stitch, for at this point in an anastomosis there is a relative weakness and sometimes a vessel is missed which may give rise to hemorrhage. Notice that the needle is passed from within the stomach to the

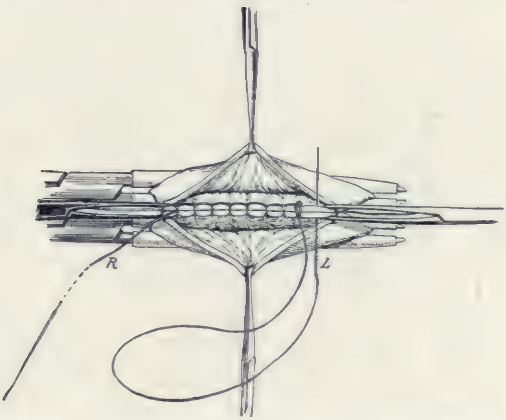

Fig. 204.—The continuous lock stitch for inner row.

outside, then turns and enters the lumen of the jejunum. This procedure makes a very accurate approximation of the angles (Fig. 205). With the same needle we now proceed to bring the mucosa of the upper stomach lip and the mucosa of the lower jejunal lip together. Since both these lips show a protrusion of the mucous membrane this suture approximates only the mucous membrane. This suture proceeds from the patient's left to right as a continuous suture. Approaching the extreme right hand of the anastomosis, this suture is tied with its fellow Dulox and the excess of suture with needle cut off (Fig. 206). Taking up the remaining needle of the double Dulox thread, we proceed

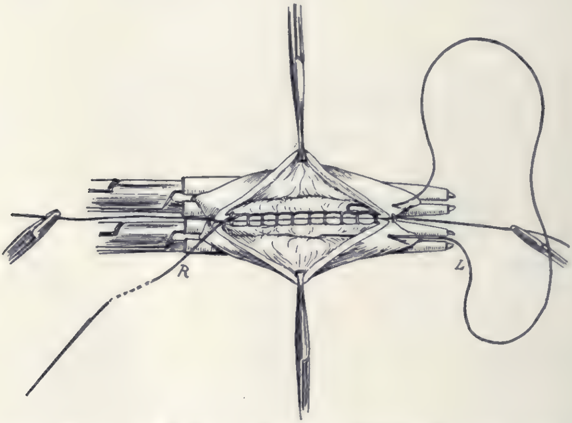

Fig. 205.—The angle stitch at left-hand extremity. (Patient's left.)

from the patient's right to left with a continuous suture which brings together the serosa (Fig. 207), and when this suture reaches the extreme left of the anastomosis it is tied, and we have completed the inner union of jejunum to stomach by one posterior lock stitch and two anterior continuous sutures. The first suture (single Dulox) that was employed is now picked up from under the laparotomy pad, and the peritoneum of jejunum and stomach are approximated by sewing from the patient's left to right by a right-angled Cushing stitch (Fig. 208). The anastomosis is now complete. The holding clamps are removed, the suture line wiped dry, and the transverse colon is lifted up and to the left. We see again the aperture in the mesocolon through which the stomach protrudes, and we suture the circular edge of the cut mesocolon by three or four linen sutures to the stomach, never to the suture line of the anastomosis of the gastrojejunostomy. It is necessary to suture the mesocolon to the stomach accurately, but with interrupted sutures so as to prevent any herniation of intestinal viscera into the lesser peri-

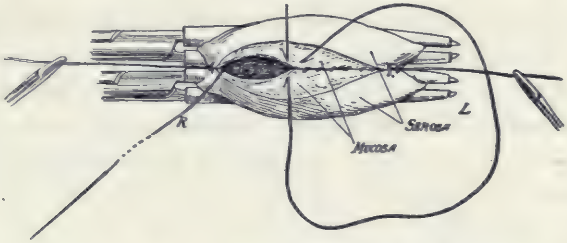

Fig. 206.—Approximation of the mucosa of stomach and jejunum. (First row anterior.)

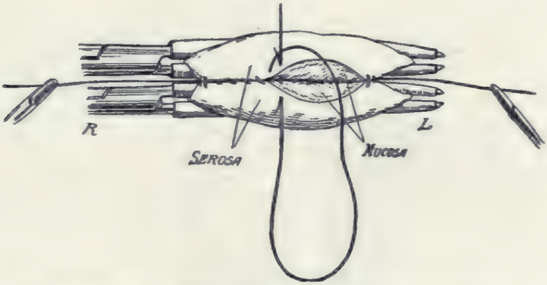

Fig. 207.—Approximation of serosa of stomach and jejunum. (Second row anterior.)

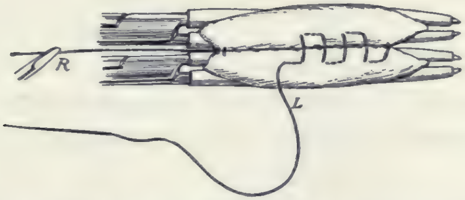

Fig. 208.—The right-angle Cushing stitch for final approximation of serosa. (Third row anterior.)

toneal cavity (Fig. 209). A final inspection of the site of the gastrojejunostomy is made. The transverse colon and omentum are replaced more or less in their natural position and the abdomen closed without drainage.

The cause of death in surgery of the upper abdomen is primarily due to anatomic factors, such as hemorrhage, acute dilatation of the stomach, shock, and seldom does the element of infection become dominant as a cause of death. In operations upon the liver and biliary passages in persons with chronic or habitual jaundice there is in addition to the anatomic factors that may produce death another element, that of liver exhaustion. In long-continued toxemic processes the reactive hepatic function is lost and patients are unable to react from a moderate degree of operative toxemia. This is particularly apt to occur in operations on the common duct and in conditions associated with chronic pancreatitis. The condition is one of complete vasomotor collapse with wet, leaking skin, tendency to anuria and death, with a clinical picture not unlike shock.

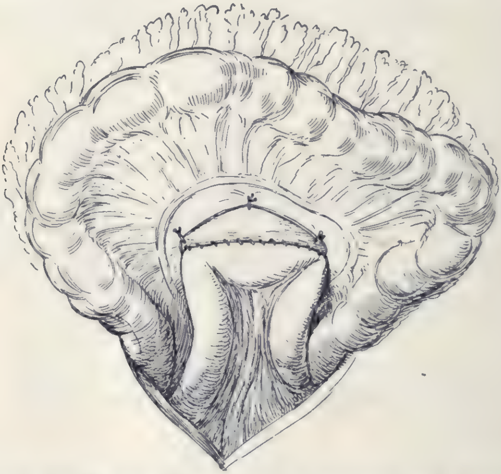

Fig. 209.—Suture of cut edge of mesocolon to stomach with three interrupted linen sutures.

In surgery of the lower abdomen the cause of death is infection and not anatomic conditions. The mortality in gastro-intestinal surgery can be represented by an ascending line which reaches the maximum point with death from peritonitis in operations on the large bowel and least in operations on the gastroduodenal segment.

In closing the abdominal wound we try to bring about the closure in as nearly an anatomic fashion as is possible: (1) peritoneum; (2) fascia, and (3) skin, supporting the entire wound with figure-of-eight silkworm sutures through skin and fascia. No drainage will be employed.

Postoperative Treatment.—The postoperative treatment of this patient will consist of: (1) nothing by mouth for twelve to twenty-four hours; (2) slight Fowler position or slight elevation of the shoulders by means of two or possibly three pillows; (3) morphin (gr. $\frac{1}{5}$) every four hours for pain or restlessness; (4) routine Murphy proctoclysis consisting of tap-water (not saline) 1000 c.c., glucose 100 grams, sodium bicarbonate 50 grams. This to be repeated once or twice during the twenty-four hours.

At the end of twenty-four hours and in the absence of vomiting 30 c.c. of water will be given every twenty minutes. If this is well tolerated, at the end of thirty-six hours water is usually given with very little restriction as to amount. At the end of forty-eight hours, broths, peptonized milk; at the end of seventy-two hours, broths, milk in unrestricted quantities; and at the end of four or five days, ordinary soft milk preparations (custard, blanc mange, ice-cream); and at the end of a week to ten days, limited regular hospital diet.

In the absence of temperature, increased pulse-rate, or local pain the wound will not be dressed for seven days, when a clean dry dressing will be applied. The silkworm sutures are removed on the twelfth day and the patient allowed up some time about the twelfth or fourteenth day.

After-result.—Patient made an uneventful recovery and left the hospital on the twenty-third day after operation. Wound in excellent condition.

CHRONIC APPENDICITIS; PYLORIC SYNDROME; APPENDECTOMY

Pyloric Syndrome: a Reflex Manifestation of Disease of the Appendix. Indefiniteness of Appendical Dyspepsia. Pain Over McBurney's Point Seldom Indicative of Chronic Appendicitis. Gastric Reflex Disturbances More Readily Induced by Chronic Infection of Appendix than Local Pain. Appendectomy Technic. After-treatment.

History.—The patient I am presenting is a woman thirty years of age, married, residing in the United States for the past ten years. She enters the New York Post-Graduate Hospital complaining of "sick stomach," nausea, and vomiting, periodically for the past two years. She has had in all six attacks, and each succeeding attack is more severe than the previous one. Her past history is negative. Menses began at sixteen, regular, duration three to four days, with an after-day of "spotting," moderate amount, and occasionally has pain, but rarely goes to bed during the period. The patient has had one child born with forceps and with laceration of the cervix and vagina, with an immediate perineorrhaphy.

Her present trouble began two years ago, and since then has manifested itself by six attacks of "indigestion." The patient feels comparatively well until the attack, when she would be seized with cramplike pain in the epigastrium with nausea. The attack usually lasted from three to ten hours, and the last attack was the most severe of all. These attacks came on first with a feeling of nausea and are followed by regurgitation of "sour water" into the mouth. Within an hour pain occurs which begins in the epigastrium, spreads over to the right side, radiates to the back. It is of a knifelike character and intermittent rather than continuous. The pain has been so severe that she has had to go to bed during the last three attacks, and necessitated the calling of a doctor in order to obtain relief. The pain remains from three to ten hours, then subsides, and the patient feels comparatively well until the next attack.

The attacks have usually occurred either at 6 P. M. or after midnight, although two of the attacks have occurred in the daytime. The patient is able to eat food, but has no great desire for it during the attack, and such food as she has eaten has never borne any relationship to the character, intensity, or localization of the pain. The patient has never been jaundiced; has never observed any blood in her stool, nor has she taken soda bicarbonate for the pain or reguritation. The most recent attack began about a week ago and subsided within twenty-four hours.

The physical examination at the present time is comparatively negative except for some general abdominal sensibility. In the seven days that the patient has been under observation she has been afebrile, with a pulse-rate between 70 and 80, and resting in bed in comparative health. Wassermann is negative and pupils react to light and accommodation. The reflexes are normal.

Radiographic examination of the gastro-intestinal tract shows a medium-sized stomach of the orthotonic type. The pylorus is of the spastic type, seen high, and to the right at the level of the third lumbar vertebra. There is no true intrinsic gastric defect, though a shelving appears in the pars cardia, apparently due to gas distention of the splenic flexure. The bulbus is small and when filled is triangular in shape and smooth in contour. Peristalsis is visualized over both curvatures. The antrum is not distended. Evacuation is rapid. There is no residue at the end of six hours. The motor meal shows fairly normal distribution in the ileum and cecum. Examination at the end of twenty-four hours shows the cecum slightly distended. It is freely movable and not noticeably tender to pressure. The appendix is not visualized.

Diagnosis: Chronic appendicitis.

Discussion.—We have here a patient thirty years of age, rather thin and of rather marked nervous temperament, who has had six attacks of pain in the epigastric region in the past two years. This pain is preceded by a sensation of nausea and the regurgitation of bitter, sour material. The attacks have come on spontaneously without warning, have been of maximum severity after they began, have had a duration of ten to twelve hours, and have been equally distributed in their time of onset during the day and night. The history is strikingly clear as to the absence of any disturbance between the attacks. One must assume, therefore, that these attacks are ushered in by a neuromuscular mechanism which disturbs the normal motor and secretory functions of the stomach as evidenced by the regurgitation of bitter, sour material. The pain is localized to the epigastrium and is of intermittent, colicky, cramplike character, and one must assume that whatever the cause or in whatever region of the abdomen this cause is operating the mechanical factor is that of hyperperistalsis or spasm. We can assume, therefore, that the pathology which induces this syndrome resides within the abdomen. It is necessary to clearly establish that this is an intra-abdominal irritation, for 40 per cent. of the indigestions are due to causes extrinsic to the stomach but within the abdomen, and 40 per cent. are due to causes entirely remote from the abdomen. Numerically the most frequent cause of indigestion is: first, heart disease; second, phthisis; third, anemia and chlorosis; fourth, neuroses or psychoneurosis; and fifth, chronic nephritis. These conditions are all remote from the abdomen and can be eliminated in this case.

If we are justified in assuming that the cause of this woman's trouble is within the abdomen, we must differentiate, roughly speaking, between intrinsic affections of the stomach and duodenum, the gall-bladder, the appendix, the pelvis, and the large and small intestines. Let us consider in detail gastroduodenal ulceration. The history of gastroduodenal ulceration is not the history as given by this patient. The evolution of an ulcer and its inherent symptomatology is such that the symptoms produced are present over a longer period than ten hours and the interval of relief is not calculated in months, but hours. This woman has an attack of pain, nausea, and regurgitation of ten hours' duration, and then is completely well for six months. This certainly is in no way similar to the regular dyspepsia of ulceration. Again, the history presented by this woman does not correspond to the history given in cholecystitis or cholelithiasis. Outside of the ten hours of her attack her gastric function is excellent. This is not the story in cholecystitis, where for a long period of time as the result of infective processes in the gall-bladder there is produced more or less continuous, although occasionally interrupted, gastric distress. Affections of the large or small intestine are certainly eliminated by the *x*-ray examination, and there is nothing to be determined by bimanual examination of the pelvis to suggest a reflex disturbance from the uterus or adnexa, so that by a process of elimination we must believe that the pathology producing the symptoms in this patient is that of a chronically infected appendix.

We are not overlooking the possibility of ureteral stone, as this has been eliminated by our *x*-ray examination.

If there is anything in the symptomatology of a chronically diseased appendix it is found in the extreme variability of the dyspepsia and the lack of regularity in the evolution of symptoms. Articles of food that at one time are associated with indigestion may be eaten with zest and relish on other occasions. The mechanism in the production of the symptomatology in the large majority of cases is probably that of pylorospasm, with pain, increased secretion, increased acidity, gaseous and sour eructations, and occasionally vomiting. This variability, in so far as its diagnostic possibilities are concerned, may be found epitomized by the statement of Moynihan that the most frequent site of ulcer of the stomach is in the right lower quadrant.

The ordinary postmortem incidence of disease of the appendix is approximately 17 per cent. It is interesting to note that the appendix shows pathologic changes in 69 per cent. of the cases of cholecystectomy, whereas 55 per cent. show disease of the appendix in cholecystostomy. It must not be forgotten that chronic disease of the appendix may occasion a rather severe hematemesis. Gastric ulcer is associated with disease of the appendix in 54 per cent. of cases, while duodenal ulcer is associated with disease of the appendix in 66 per cent. of cases, and in 15 per cent. of all laparotomies there are two lesions sufficiently severe to warrant operation.

Hutchinson records 24 cases of fatal hemorrhage from the stomach after operations of various kinds upon the abdominal viscera. Of these 24, 21 were cases of appendicitis with septic complications. I have records of 4 cases of pronounced gastric hemorrhage which on very extensive abdominal exploration revealed no morbid process except in the appendix, and following an appendectomy there was a cessation of gastric distress and gastric hemorrhage. Gastric hemorrhage has been experimentally produced by Rogers by injecting chemical irritants into the cecum and ascending colon, while irritation of the colon, *per se*, has been shown to bring about a gastric stasis and the delayed passage of food material through the small intestine.

Barclay quite recently has drawn attention to the spasmodic closure of the pylorus following reflex stimulation from the terminal ileum, when there is too rapid overloading of the small intestine with chyme. Biologically the ileocecal valve represents a great point of chemical and bacterial partition, for at the cecum we have a change in chemical reaction: maximum bacterial flora, maximum fluidity, anastalsis, predominant lymph tissue, and a point of natural or normal stasis. These observations would seem to offer proof of a very extensive system of intra-alimentary reflexes acting upon the pyloric mechanism, and it would serve to explain the incidence of appendicular dyspepsia.

"Appendix dyspepsia" is a varied and indistinct clinical picture. It is usually more difficult to diagnose than either the conditions of ulcer or disease of the gall-bladder. If one can eliminate either of the two conditions named above it should be possible to arrive at a diagnosis of appendicular dyspepsia by elimination. In the ordinary case there is usually an absence of a history of an acute attack. Epigastric distress is a source of intermittent annoyance or sense of ache, and usually with no distinct relationship to food. The pain or distress is apt to be aggravated by activity and motion and is occasionally relieved by an enema or a cathartic. It is infrequent for appendicular dyspepsia to be associated with a history of acute attacks, although occasionally local appendical pain may be elicited.

It is noteworthy that the pain and distress is usually more prolonged than similar occurrences in disease of the gall-bladder. The distress is usually located low down in the epigastrium or at about the navel, and lacks the distinct characters of localization as in biliary disease.

Another interesting factor in this patient's history is that the attacks have been becoming more severe, each succeeding attack being more intense than the preceding ones and with a tendency toward shortening of the interval between attacks. I think that this can be explained by the relatively increasing stenosis of the appendical lumen. With each attack there ensues a slight increase in the degree of infection resident in the appendix, and with the tumefaction and edema and temporary occlusion of the appendix there is produced retention of infected feculent matter. In the spasm of the walls of the appendix in its effort to rid itself of the retained contents a pronounced irritation is given to the entire small intestine, to the ileocecal valve and to the pylorus, and the hyperactivity of the small intestine demonstrates the physiologic law that wherever in the gut tube there exists a point of irritation there is an increase in the normal functions of the gut segment above the point of irritation, and we have hypermotility and hyperperistalsis of the small intestine. The reflex pylorospasm may account for the increase in secretion and the disturbed motor function of the stomach. After the appendix has been able to free itself of its retained contents resolution takes place, leaving behind an appendix slightly more susceptible to another attack, and the cicatrices which exist in the form of strictures within the lumen of the appendix make for increased severity with each succeeding attack. Accordingly, from all angles it seems that the clinical picture herein presented is best explained upon the assumption of a diseased appendix.

It is interesting to note that the cases that we have operated upon for chronically diseased appendices and whose only complaint was pain in the right lower quadrant have, as a rule, not been uniformly benefited by the operation. Where we have corrected a dilated or atonic cecum or done a cecoplication and, more rarely, cecofixation, or have attended to a gross pathologic change in the cecal region or in the tube and ovary, these cases have been cured of the pain in the right lower quadrant, but where a simple appendectomy has been done for the sole complaint of pain in the right lower quadrant we have been chagrined to find that these patients have not been cured by an appendectomy. Accordingly, a symptomatology embracing only pain in the right lower quadrant without any other confirmatory sign is usually not the type of abdomen that is going to be cured of its pain by an appendectomy. On the other hand, cases that have had a subacute attack of appendicitis with so-called appendicular colic of epigastric pain, nausea, eructations or vomiting, and then a subsidence of the symptomatology, have been uniformly cured by the removal of the appendix.

Operation: Incision.—It is essential in this patient not to overlook any pathologic process in the gastroduodenal zone, in the gall-bladder, kidneys, sigmoid, or pelvis.

Accordingly, we will make our incision somewhat higher on the abdominal wall than one would ordinarily make for a simple appendectomy. We seldom use the McBurney intermuscular incision on account of the inability to properly explore the abdomen, and this patient certainly has the right to a thorough exploration of her abdominal contents which can only be carried out by a properly placed incision.

Our incision will begin 2 inches above the level of the navel and 1 inch from the median line, and continue down a distance of 2 inches below the level of the navel. The anterior sheath of the rectus will be divided and the fibers of the rectus muscle split in the direction of the incision. This incision allows us to extend it either upward or downward, depending upon any secondary pathologic process that may be discovered. We first ascertain the condition of the pylorus, and we find there is a normal pyloric ring, no ulceration of the duodenum or in the stomach; the gall-bladder is normal in color, its walls are thin, there is no deposition of saffron-colored fat, and by introducing two fingers into the foramen of Winslow we ascertain that the common duct is normal, that there are no enlarged glands about the cystic or common duct, and that we have a negative biliary system. The spleen is normal in size and the left kidney is normal in size, shape, and mobility. The uterus has a very small fibroid on the anterior surface about the size of a hazelnut and both tubes and ovaries are normal. By carrying out a systematic exploration in this manner we have left the region of the cecum and the appendix for our operative procedures. The cecum and appendix are delivered out of the abdomen, and we find that the appendix is kinked at its midportion, that it has a bulbous extremity with three very distinct points of constriction. It is held down to the external lateral peritoneal wall by an adventitious adhesion and we will divide this. By cutting this adhesion with a scissors the appendix rides free and can be delivered easily out of the wound (Fig. 210). By making gentle traction upon the end of the appendix with an Allis clamp the meso-appendix is straightened out and the blood-vessels are easily discerned. Note beneath the border of the meso-appendix the ureter passing down over the iliac vessels to enter the pelvis. The proximity of the appendix to the ureter explains many cases

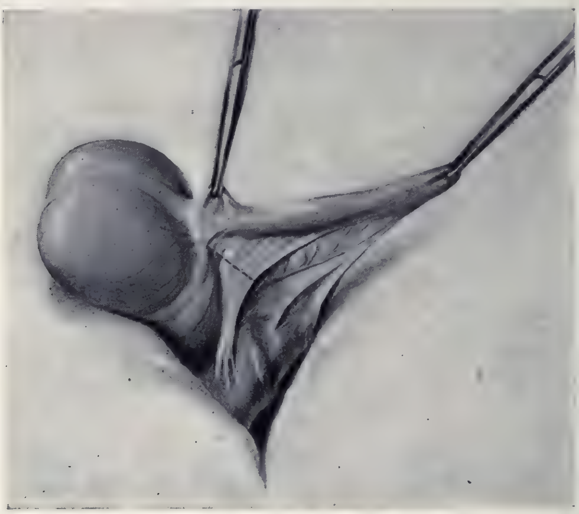

Fig. 210.—Appendix delivered and made taut by grasping with Allis' clamp. Division of adventitious bands as indicated. Note ureter passing over iliac vessels.

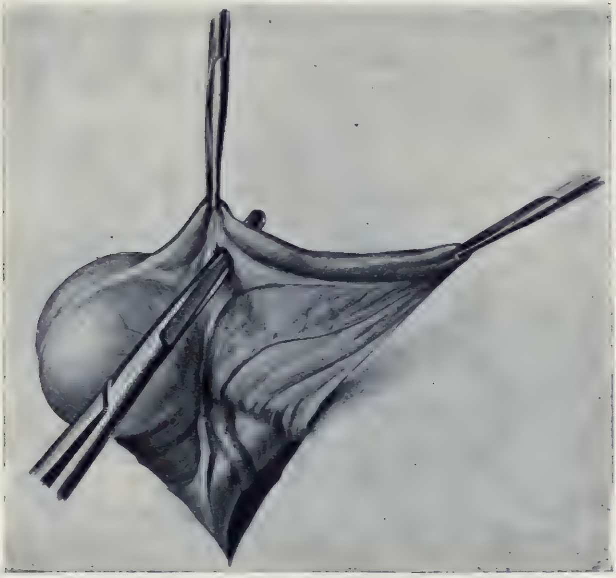

Fig. 211.—Perforation of meso-appendix preparatory to clamping.

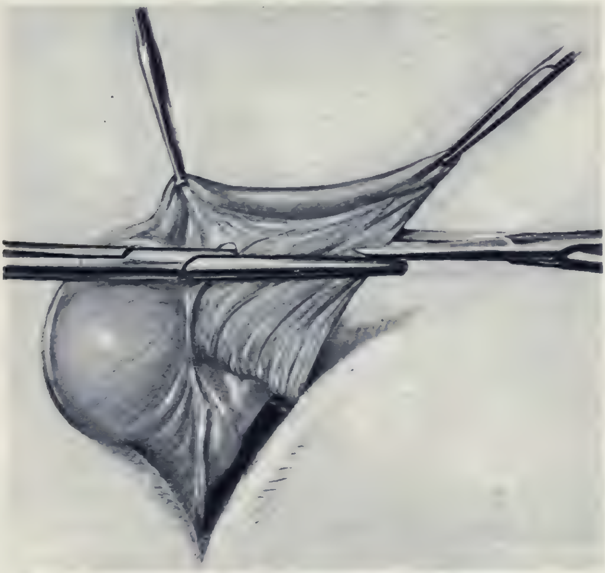

Fig. 212.—Clamping of the meso-appendix and dividing so as to free the appendix. If the meso-appendix is long and wide it may be necessary to employ two or three artery clamps.

of irregular attacks of supposed renal colic with a showing of blood and pus in the urine. The reverse of this condition is very interesting where a small stone impacted at the brim of the pelvis may simulate a chronic appendicitis. The meso-appendix is transfixed close to the cecum (Fig. 211) and a clamp applied to the meso-appendix (Fig. 212). If the appendix is long or there is an unusual width to the meso-appendix it may be necessary to use two or three clamps after this manner in order to properly divide the meso-appendix for ligation. We will tie the meso-appendix with No. 2 plain catgut (Fig. 213) and will now crush the appendix close to the cecum (Fig. 214). The purpose of crushing the appendix is to destroy the mucous membrane and

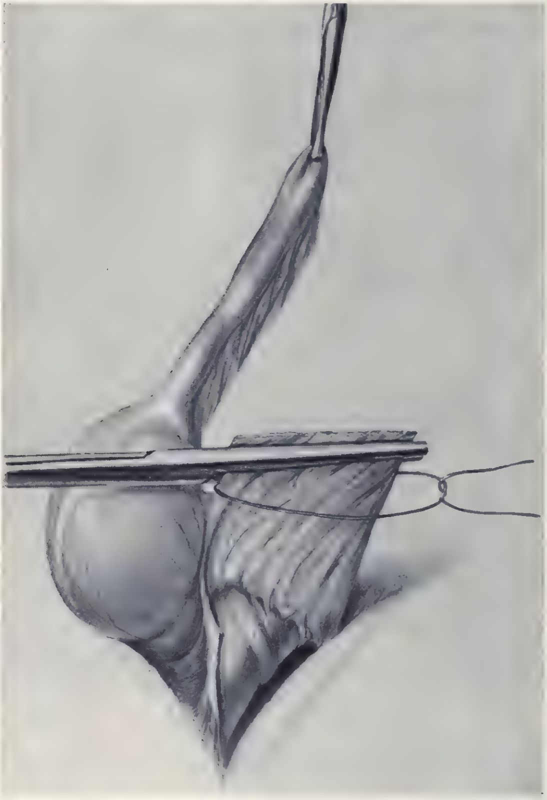

Fig. 213.—Ligation of the meso-appendix with No. 2 plain catgut.

thereby bring about the obliteration of the lumen of the inverted stump of the appendix much more readily.

We ligate the appendix in the crushed area with No. 2 chromic catgut. The next step in our operation is to pass a purse-string with Pagenstecher thread so as to make a loop enclosing the stump of the appendix and with a diameter of about 1½ inches. This purse-string begins at the side opposite to us and each succeeding stitch transfixes the head of the cecum at regular intervals. If one considers the head of the cecum as representing the dial of a watch, with 12 o'clock directly oppo-

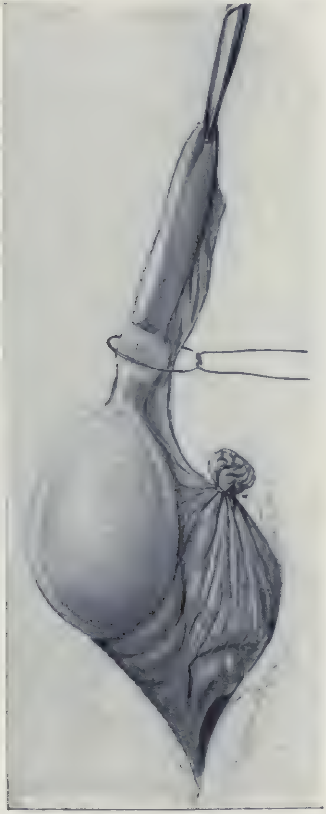

Fig. 214.—The appendix crushed with artery clamp—close to cecum and in crushed area ligated with No. 2 chromic catgut.

site, our purse-string suture is placed by beginning at 12 o'clock, transfixing at 10, 8, and 6. A small loop is left at 6 o'clock and the purse-string continued by transfixing at 4, 2, and back to 12 (Fig. 215). We have now placed the purse-string and will proceed to amputate the appendix. A small piece of gauze is placed beneath the appendix and the appendix is clamped about 1 cm. distant from the ligature occluding the appendix. The clamp is placed on the appendix to prevent back-flowing of contents, and with a knife the appendix is divided between the ligature and the clamp (Fig. 216), and the clamp, gauze, and appendix are removed *in toto*, leaving the stump of the appendix standing erect by reason of the traction made with the purse-string. The stump of the appendix is touched with pure phenol,

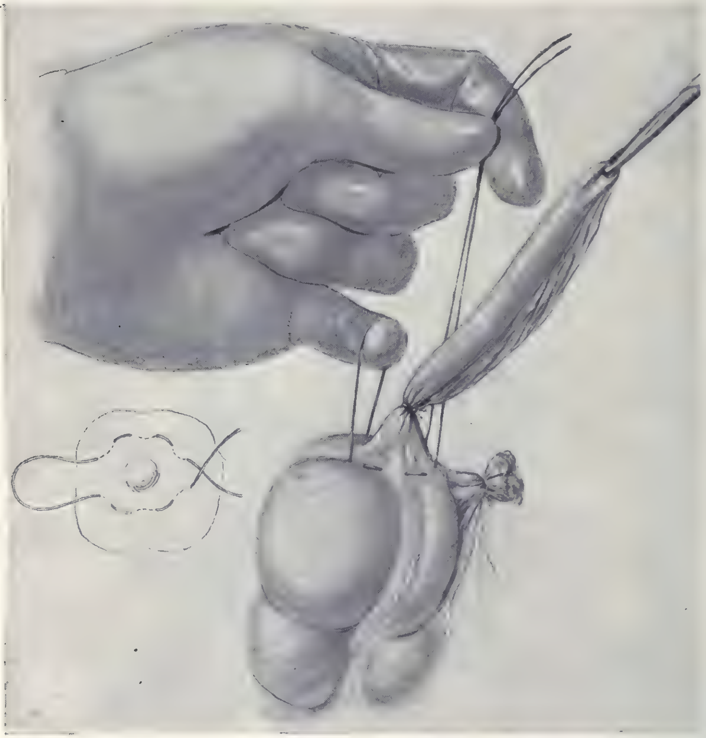

Fig. 215.—General appearance of the purse-string showing two divergent points of traction. Appendix tied and ready for amputation.

but is not neutralized with alcohol, and with a plain thumb forceps the stump of the appendix is inverted into the head of the cecum. At the moment that that stump of the appendix is inverted below the level of the purse-string the loop is slipped off the little finger and a quick jerk of the two threads between the thumb and first finger completely occludes the aperture and permanently inverts the stump of the appendix (Fig. 217). We have used this technic almost uniformly in this clinic for the past eight years and have been well pleased with it. Its distinct advantages are that there is no soiling of the operator's fingers nor of the nearby tissue, and the inversion of the stump of the appendix is complete and easily accomplished on account of the cecum being held at two divergent points, the one by the loop over the little finger and the other by the two threads between the thumb and the first finger.

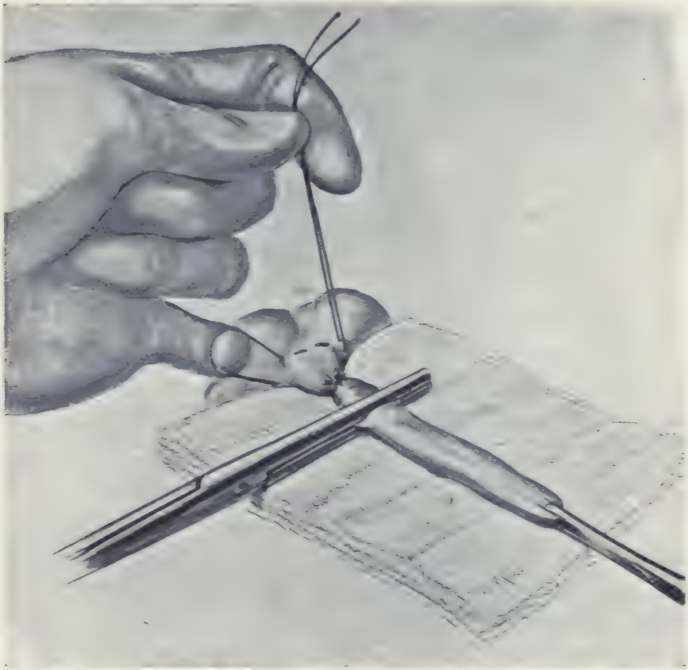

Fig. 216.—Amputation of the appendix between ligature and clamp. The appendix, clamp, and gauze removed all in one piece.

Postoperative treatment of this patient for the first twelve hours will be: (1) nothing by mouth, (2) slight Fowler position, (3) Murphy proctoclysis, and (4) morphin sufficient to keep the patient quiet and free from restlessness.

After-result.—The patient was dressed on the fifth and tenth days after operation. She made an uneventful convalescence and was discharged from the hospital on the tenth day after operation. The wound was in excellent condition.

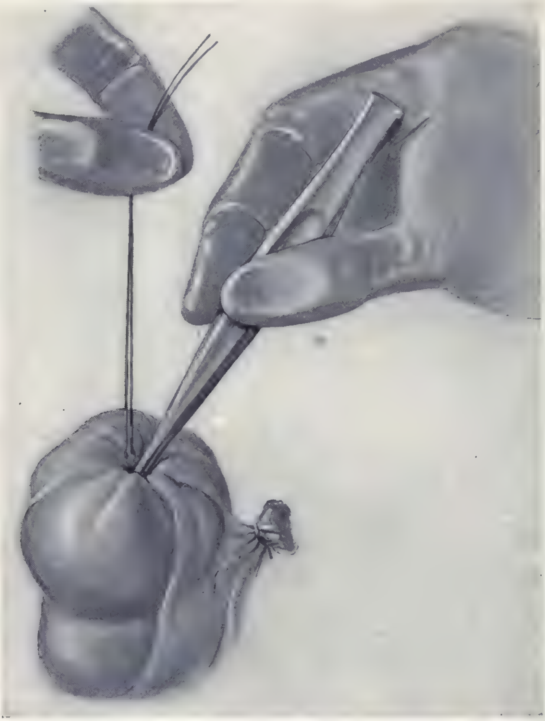

Fig. 217.—Inversion of the stump of the appendix. While holding loop of purse-string over little finger and the two free ends between thumb and first finger the appendical stump is inverted, and at the same time the loop is slipped off little finger and the two free ends pulled taut and tied.

It is rather early to determine the eventual cure of this patient, but up to the present time (April 1, 1921) the patient states that she has enjoyed better health than at any time in the last ten years.

CHOLELITHIASIS; CHOLECYSTECTOMY; APPENDECTOMY

Cholecystitis, Cholelithiasis, Diagnosis of Biliary Disease. Differential Diagnosis from Gastroduodenal Ulceration and Diseased Appendix. Discussion as to the Merits of Cholecystectomy and Cholecystostomy. After-results in Biliary Disease. Technic of Cholecystectomy.

History.—The patient I am presenting this morning is a woman twenty-six years of age, married, born in Russia, but resided the last six years in the United States. She entered the New York Post-Graduate Hospital complaining of "pain in the upper abdomen," right side, for the past two years and markedly worse during the past two months. The family history is unimportant. The patient has never had typhoid fever or any septicemic process of pronounced type. She has had two children, one two and a half years of age and the other seven months. The patient's menstrual and obstetric history is negative.

In narrating the story of the present illness the patient states that she has had more or less continuous "stomach trouble" for the past two years. This affection has been variously ascribed to "nervous stomach" and "gastritis." During the period of this so-called stomach trouble the patient states that there have been intermittent attacks of gas which would form in the upper part of the abdomen, followed by belching and occasionally by vomiting. For the past two months this gaseous dyspepsia has given place to intermittent attacks of pain, of cramplike character, coming on at irregular periods, mostly at night, and on two occasions the pain was so severe as to require hypodermic injections of morphin. For the last ten days the pain has been more or less continuously present and is described as a dull aching pain confined mostly to the right upper quadrant. There is no history of jaundice. The patient has been under observation for the last week, during which time she has had a normal temperature, pulse, and respiration rate. A physical examination of the abdomen reveals a markedly thick abdominal wall with tenderness in the right upper quadrant. There is a marked inspiratory spasm upon deep infracostal pressure when the patient takes a full inspiration (Murphy sign). There is no tenderness over the region of the appendix and the pelvis is negative upon bimanual examination. The pupils react to light and accommodation and the reflexes are normal.

No *x*-ray examination has been made of this patient because we are reasonably sure of our diagnosis. We believe this woman has a chronic cholecystitis with gall-stones.

Discussion.—A critical analysis of this woman's history reveals that her trouble has its symptomatic evolution in two phases. The first is represented by a period of gaseous indigestion and the second by the acute onset of attacks of pain. From the chronologic order of her symptoms no less than the specific character of her complaint one is justified in making the diagnosis of cholecystitis.

If we conceive the stomach as exercising in the main two functions—that of motor function and secretion—we may reasonably expect that any irritative condition that reflexly affects the stomach would probably cause an aberration in one or both of these two functions. For a long time medical opinion considered gall-stones the only pathologic evidence of diseased gall-bladder, and gall-stones were interpreted as the essential pathologic process. With refinement of diagnosis, the extraordinary development of the *x*-ray, and other laboratory procedures there has ensued a reconstruction of our pathologic conceptions of the affections of the biliary tract. From the pathologic study that has emanated from the operating room it has become definitely established that it is the infection of the biliary tract itself which gives the surgical indication rather than the accidental sequelæ or incidental occurrence of stones.

In the strawberry gall-bladder of Moynihan stones are absent, likewise in some forms of fibrosis of the gall-bladder there is an absence of stones. It is the infection that begins in the gall-bladder which sets in motion a series of changes bringing about the inaugural signs of cholecystitis—the symptoms of gaseous indigestion. This indigestion is due to motor and secretory disturbances in the stomach, reflexly produced by infective changes in the gall-bladder. In speaking of gastroduodenal ulceration we refer to the regularity of the symptomatology, while in speaking of cholelithiasis we speak of the irregularity of the dyspepsia that is produced. In gall-bladder disease the indigestion is vague, irregular, with an ill-assorted grouping of symptoms. This indigestion conforms to no rule and exhibits no constancy. It is characterized by an absence of periodicity, and it may be catalogued by its most predominant symptom, gas production—flatulency. In gall-bladder disease there are various degrees of gas production. There are eructations, sense of fulness, weight or oppression, occasionally with tenderness along the right costal margin. There may be a catch in the right side upon taking a full breath, and occasionally after large meals a slight sensation of chilliness or goose-skin sensation. This gaseous indigestion is characteristically made worse by the eating of any fried foods or greases, or less commonly apples, nuts, and cheese. There usually is some relief upon the raising or belching of gas and almost complete cessation of the symptoms upon vomiting. Occasionally the history is obtained of the patient retiring after dinner and voluntarily inducing vomiting with almost complete amelioration of the symptoms. It is worthy of note that the patient is relatively free from symptoms when the stomach is empty, in marked contradistinction to duodenal ulcer, where the patient is usually at his best when food material is in the stomach. This form of indigestion may continue for an indefinite period of time and exhibit itself without any marked variation in the above picture. After a long or short period of the above qualitative dyspepsia there is introduced into the patient's history another symptom, different from any of the preceding symptoms, and this is represented by a sudden, acute attack of agonizing pain. The onset of the second phase of symptoms is quite characteristic. Out of a clear sky, without any warning or premonition, the patient is seized, usually in the evening, with a sudden, intense, severe attack of cramp-like pain, usually in the right upper quadrant. This pain comes on like a stroke of lightning, radiates through to the back, occasionally down the right side or up over the right chest, and less frequently toward the left breast. It is of maximum intensity, is associated with restlessness upon the part of the patient, and usually so severe as to require the presence of a doctor and the hypodermic injection of morphin. This agonizing pain lasts a variable length of time, four to six hours, disappears almost as quickly as it came, leaving a residual soreness in the right upper quadrant or along the right costal margin. There may or may not be, in addition, some temperature during the height of the paroxysm.

The patient this morning exhibits these two phases in a somewhat variant degree, but certainly two facts are positive: (1) the history of gastric distress of rather mild type for two years and (2) this dyspepsia has been succeeded by a series of attacks of intense upper abdominal pain. If we add to this historic data the positive Murphy inspiratory spasm, both in the recumbent position and in the sitting position, we feel sure the patient has a chronic cholecystitis. During the reading of this history there occurred the positive statement that there had never been any jaundice. Jaundice is not a symptom of simple cholecystitis, but is usually a symptom of cholangitis or calculous obstruction within the lumen of the common duct or occasionally of infection of the cystic duct with edema and pressure upon the common duct.

In considering jaundice in biliary disease statistical inquiry has demonstrated that according to its causation jaundice may be classified in the following numeric order: (1) gall-stones, (2) catarrhal jaundice, (3) cancer of the liver, (4) cirrhosis, (5) cancer of the bile-ducts and gall-bladder, (6) cancer of the pancreas, and (7) gastric and duodenal carcinoma (Fig. 218). It will readily be seen that by eliminating catarrhal jaundice and cirrhosis of the liver the diagnosis becomes one of differentiating between the jaundice due to gall-stone disease and that from malignancy of the bile-ducts.

Catarrhal jaundice is an example of a disease named after its most prominent symptom. Its designation is without any adequate or stable pathologic basis. The diagnosis of catarrhal jaundice is one of the most insecurely founded of all diagnoses at the present time.

Jaundice that comes on with or without gastro-intestinal disturbances, that has a duration of four to six weeks, and then spontaneously clears up, must, however, with our present knowledge be designated catarrhal jaundice. The outstanding clinical feature is the slight systemic changes in the presence of jaundice. Herein it differs from all other types of jaundice where the systemic changes are marked. Emaciation during an attack of jaundice has little clinical value, as emaciation occurs equally with gall-stones, catarrhal jaundice, or malignancy. Finally,

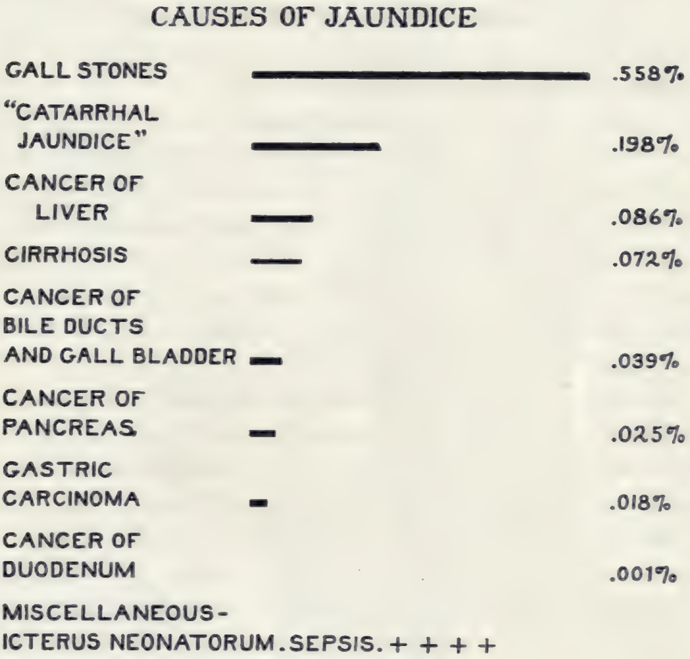

Fig. 218.—Statistical tabulation showing the causative factor in the production of jaundice.

only a "cure" within six to seven weeks can be considered as establishing the diagnosis of catarrhal jaundice.

A case of jaundice that does not clear up within six weeks is either a complication of another condition or the diagnosis is wrong. The deep green or black color of pure obstructive jaundice is never seen in catarrhal jaundice, although the effects of long-continued icterus may be evident. Stupor never occurs in the mild types of jaundice, and is absent in gall-stones and even in malignant disease except at the terminal stages. Only in two forms of liver disease is stupor a factor in the presence of jaundice, namely, cirrhosis and acute yellow atrophy.

Jaundice due to gall-bladder disease rarely develops after the first attack, and still more rarely does it appear suddenly and without colic; 99 per cent. of gall-stones are formed in the gall-bladder, and to reach the more ample common duct must migrate through the cystic duct. In the course of this migration colic is developed, and only when the calculus reaches the distal portion of the cystic duct may jaundice arise either from compression or coincidental inflammation (Fig. 219).

If one were to take the life-history of a large number of cases of disease of the biliary apparatus he would find that they presented a composite picture in which four well-defined stages of pathology were evidenced: (1) When the disease was confined to the gall-bladder; (2) when there are attacks of biliary colic; (3) when jaundice occurs from common duct obstruction, and (4) when infection or calculi produced coincident disease of the pancreas.

In our patient the history clearly exhibited the first two stages. One could predicate the subsequent development of common duct disease were the patient to continue without surgical intervention. After a variable period the third phase of biliary disease may be introduced by an attack of pain similar to the one outlined, to be followed in four to six hours with jaundice which reaches a maximum intensity within twenty-four to forty-eight hours, and associated with the evidence of a well-defined sepsis—chill, fever, and sweat, suggesting in its onset and periodicity a malarial paroxysm. Years ago this was known as intermittent hepatic fever (Charcot) and variously ascribed to malaria.

The diagnosis of calculous disease of the common duct rests upon colic, icterus, and sepsis, and the symptoms occur in that order. In cystic duct obstruction there is colic and fever, and the symptoms occur in that order, but there is no jaundice. In calculous disease of the common duct one is impressed by the fact that at the time the patient presents himself jaundice is absent in about 25 per cent. of cases. Inquiry, however, will reveal that in the larger proportion of cases (85 to 90 per cent.) there is a history of a colicky jaundice.

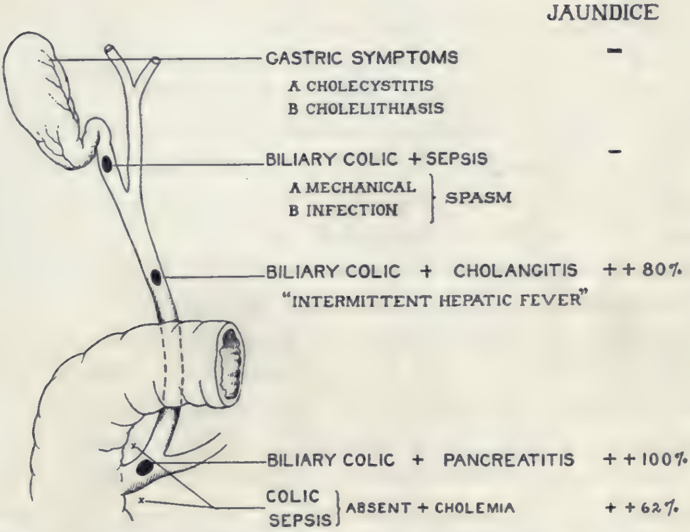

Fig. 219.—Summary of symptomatology in the "four phases" of diseases of the biliary apparatus.

The first mechanical factor in calculous obstruction of the common duct is the production of acute biliary obstruction with acholic stools. After a variable period of cholangitis, distention of the duct behind the obstructive calculus occurs, the duct dilates, and the stone floats up into the more ample and dilated common duct, and biliary delivery into the duodenum is resumed.

Between attacks of calculous obstruction of the common duct the patient may be apparently well, but is practically never free from a subicteroidal tint or slight jaundice. The patient is designated as sallow, when she is really suffering from a continuous and persistent low-grade jaundice or a jaundice of remittent intensity. Many of these patients who are persistently sallow notice that the jaundice varies during the day, becoming deeper toward evening. With each attack of pain and jaundice there is a fever of a characteristic "steeple chart" type, while early in calculous obstruction the liver is enlarged and generally the spleen.

The resultant pathologic condition is a dilated and infected common duct with a calculus floating up and down—the ball-valve stone of Osler and Fenger—and the mechanical factor is chronic intermittent intrinsic occlusion of the common duct.

Stone in the common duct is preponderantly the result of a previous infection of the gall-bladder and predicates a chronic cholecystitis with cicatrization and contracture. In 187 cases of obstruction of the common duct reported by Courvoisier in 100 obstruction was due to causes other than stone and in 87 the obstruction was due to calculous impaction. Of the 100 cases in which obstruction was due to causes other than stone, in 92 there was a dilatation or distention of the gall-bladder, and in 8 cases there was a normal gall-bladder or an atrophy of the gall-bladder. Of the 87 cases in which obstruction was due to stone, in 70 cases the gall-bladder was atrophied and in 17 cases the gall-bladder was dilated. Courvoisier then enunciated his law: "In cases of chronic jaundice due to blocking of the common duct a contraction of the gall-bladder signifies that the obstruction is due to stone; a dilatation of the gall-bladder, that the obstruction is due to causes other than stone."

In reporting the cases of the Massachusetts General Hospital Cabot found 86 cases of obstruction of the common duct: 57 were due to calculous obstruction; in 47 the gall-bladder was atrophied; in 8 it was normal; in 2 enlarged; 29 cases of obstruction were due to causes other than stone; in 27 the gall-bladder was distended, and in 1 the gall-bladder was empty and 1 contracted around calculi. "Four cases only of this series were exceptions to Courvoisier's law. With the exception of these 4 cases, which constituted only 5 per cent. of the total number examined, every record of the Massachusetts General Hospital series in which definite statements are to be found concerning the patients at issue goes to confirm Courvoisier's law."

In 84 per cent. of cases with stone in the common duct we find a contracted gall-bladder. Therefore a case of obstructive jaundice with (1) history of colic; (2) distinct variations in the intensity of the jaundice (remittent or intermittent)—"ebbs and flows"; (3) absence of distention of the gall-bladder; (4) presence of septic reaction—chill, fever, sweat, leukocytosis; (5) continuous or occasional absence of bile in the feces; (6) chronicity is almost positively due to calculous cholangitis.

Operation: Incision.—The standard incision in this clinic for exposing the right upper quadrant and giving access to the region of the gall-bladder or pylorus is made by taking a point midway between the costal margin and the ensiform cartilage and extending the incision downward and slightly outward, to terminate about 1 inch to the right of the navel. Such an incision allows us to displace the major portion of the right upper rectus muscle to the right and so conserve the nerves which enter the body of the muscle. It is to be remembered that the superior portion of the recti muscles divaricate from the median line and spread out fanshape for their insertion to the costal cartilage.

In entering a relatively clean abdomen our first procedure is to explore the abdomen for other areas of pathology. We carry out a rather definite system in doing this. First, we inspect the pylorus at the union of the superior and inferior pyloric veins. Second, we test the patency of the pylorus by insinuating either the thumb or first finger into its lumen or orifice. Third, by displacing the stomach to the right we expose the duodenum and recognize that it is perfectly clear. Introducing our hand into the abdomen we pass over the spleen, palpate the left kidney, continue it on down, to determine that the sigmoid is free and, in the female, palpate the uterus and adnexa. Continuing on over to the right we deliver the cecum up into the wound if possible, and here perform a primary prophylactic appendectomy. (See technic, chronic appendicitis, pyloric syndrome, appendectomy, page 525.) In this case we find that the cecum is slightly fixed to the right lower quadrant and is somewhat dilated, with marked evidence of a pericolonic membrane. This appendix shows some stasis by reason of the fact that it is kinked at its midpoint and held by the pericolonic adhesions. We will incise the external surface of the meso-appendix, which will allow the appendix to ride free of its retaining adhesions and be delivered out of the abdomen in order to permit a typical appendectomy.

It is almost an invariable rule to remove the appendix in affections of the stomach, duodenum, or gall-bladder. So frequently is the appendix the cause of reflex gastric disturbances that we feel it should be a rule to remove the appendix from the patients when they have in any way complained of gastric disturbance.

Reserving for the last the examination of the field which gave the indication for operation, we find here a gall-bladder chronically diseased. We palpate a number of stones in the gall-bladder. We recognize the adhesions extending down from the gall-bladder to the gastrohepatic omentum, and we now introduce the first and second fingers of the left hand into the foramen of Winslow and carefully palpate the common duct. We do not find the common duct enlarged. The head of the pancreas feels of normal consistency and contour. There are, however, a few adhesions between the under surface of the liver and the hepatic flexure. Withdrawing our hand, we palpate the right kidney, and find it of normal size, shape, and with normal mobility.

It has been found that about 80 per cent. of the chronically infected gall-bladders contain stones; 20 per cent. do not. There are certain unmistakable signs of a non-calculous infected gall-bladder. We have been in the habit of tabulating these signs in the following order: (1) The loss of normal color of the gall-bladder; (2) a thickening of the wall of the gall-bladder; (3) the deposition of saffron-colored fat extending well up toward the fundus; (4) the presence of organized adhesions between the gall-bladder and stomach or duodenum or colon; (5) the inability to readily empty the gall-bladder by gentle compression; (6) the presence of enlarged glands in the triangle of Calot or along the common duct; (7) visual inspection of the mucous membrane of the gall-bladder by cholecystotomy.

In the last few years a great deal of discussion has taken place whether a routine cholecystectomy should be performed or cholecystostomy. In this clinic we have been removing more and more gall-bladders as our routine surgical procedure. There is something to be said on both sides of the question. The operation of choice can be summed up, however, under the following heads: mortality, curability, morbidity, and general effect upon metabolism. The mortality is relatively the same. If anything, cholecystostomy has a slightly lessened mortality. The simplest cases usually have cholecystectomy, while the graver inflammatory cases are drained, so in 100 cases with drainage of the gall-bladder there would probably be a greater degree of pathologic change than in 100 cases with cholecystectomy. The curability is slightly better with the cholecystectomy, as it is not an uncommon experience to have to reoperate gall-bladders that have been drained.

In non-operated cases there are relatively few deaths from actual disease of the gall-bladder, but there is almost always a long-continued morbidity; 7 per cent. of the cases with gall-stones in the gall-bladder are associated with pancreatitis, and the incidence of pancreatitis rises almost to 70 per cent. in cases where calculi are lodged in the terminal portion of the common duct.

The effect of removal of the gall-bladder upon metabolism is apparently very slight. Under normal circumstances bile is ejected into the duodenum in intermittent spurts, whereas after removal of the gall-bladder bile passes into the duodenum in almost a continuous stream due to the uniform dilatation of the common duct after cholecystectomy from paralysis of the sphincter of Oddi at the ampulla of Vater.

The condition of the gall-bladder in this patient is such that we believe cholecystectomy is the operation of choice.

We introduce our laparotomy pads to protect the adjacent viscera and grasp the fundus of the gall-bladder with a hemostat. Upon making traction the gall-bladder is slightly delivered into the wound. Upon passing the right hand above the surface of the liver toward the dome of the diaphragm we are able to mobilize the liver, so to speak, and allow the right lobe of the liver to be lifted into the wound. This maneuver permits almost the entire gall-bladder to come into the operating field. Hartmann's pouch is now grasped with a second artery clamp and with a scissors the peritoneum binding Hartmann's pouch to the cystic duct is incised. This allows Hartmann's pouch to rise up from the cystic duct and readily allows the cystic duct to be defined for clamping. If there were any possibility of infection of the common duct we would ordinarily drain it through the cystic duct.

We now clamp the cystic duct. There is a very safe procedure for clamping only the cystic duct. Upon taking a curved hemostat we pass it from below upward through Calot's triangle—the space represented by the common hepatic duct, the cystic duct, and the under surface of the liver. After transfixing this clear space the clamp is opened *in situ* and thereby creates an aperture into which is placed a clamp which grasps firmly the cystic duct. A second clamp is placed above and the cystic duct divided between the two clamps. The first clamp may or may not take in the cystic artery. If it does not, the cystic artery is grasped independently. If any stone is found in the cystic duct it is milked back toward the gall-bladder and the clamps inserted below the stone. It is of the utmost importance that these procedures should be done by sight, as the danger to the common hepatic duct or the individual hepatic ducts is by no means negligible, and great care should be taken to prevent injury to these important structures.

After division of the cystic duct or the cystic duct and cystic artery these structures are ligated with No. 2 chromic catgut. Following this the gall-bladder is dissected freely from its fossa and from the under surface of the liver. Occasionally the flap of peritoneum left after excising the gall-bladder is sutured over with No. 2 plain catgut so as to close in the fossa of the gall-bladder. We now introduce a cigarette drain to Morrison's space—Morrison's space being a purely surgical space represented by the area between the superior pole of the right kidney and the under surface of the liver. The object of this drain is to provide an outlet in case the ligature on the cystic duct "slips-off" and results in a biliary discharge.

Closure.—The abdomen is closed in the typical manner by anatomic reposition of the various layers. The cigarette drain is allowed to emerge at any point in the incision that is most direct to the area operated upon.

Postoperative treatment of this patient will be that of a potential peritonitis, namely:

1. Nothing by mouth for twelve hours.
2. Slight Fowler position.
3. 1000 c.c. of tap-water by rectum with 10 per cent. glucose and 2 per cent. soda bicarbonate added to it.
4. Morphin, gr. $\frac{1}{5}$, p. r. n., for pain or restlessness.

After-result.—The patient had an uneventful convalescence. The cigarette drain was removed at the end of seventy-two hours and the wound dressed on the fifth and tenth days, and the patient was discharged with primary union on the twelfth day after operation.

SWALLOWING OF SMALL HAT-PIN 5 CM. IN LENGTH, WITH PENETRATION OF DUODENOJEJUNAL JUNCTION. EXPLORATORY LAPAROTOMY; REMOVAL OF FOREIGN BODY

Frequency of Children Swallowing Foreign Bodies. Swallowing of Small Beaded Pin Without Symptoms for Seven Days. Ease of Diagnosis with *x*-Ray Examination. Advisability of Surgical Intervention for Removal. Dangers of Laparotomy. Postoperative Treatment.

History.—The patient I am presenting is a girl fourteen years of age. Seven days ago she removed a black-headed pin $2\frac{1}{2}$ inches long from her hair and put it in her mouth. Throwing back her head to listen to something that was being said she took a deep breath and the pin disappeared. She tried to cough it up, but did not succeed. *x*-Ray examination two days after swallowing the pin demonstrated it in the stomach; second examination five days after the accident located the pin in the third portion of the duodenum (Fig. 220). The radiographic examination two days ago showed what appeared to be a glass-headed pin, measuring about $1\frac{1}{2}$ inches in length, the head a little over $\frac{1}{8}$ inch in diameter, situated at the duodenojejunal junction (point downward). This location was determined by the administration of a barium meal. The pin was found to remain in this fixed position on two successive examinations.

The diagnosis in this case is quite easily established, and the sole question before us relates to the advisability of surgical intervention at this time, and also a consideration of some of the difficulties that may be encountered.

This pin has remained stationary in the same location for five days. It resided in the stomach for two days, and then on the fifth day was in the duodenojejunal flexure, and at the end of seven days in the same place.

The sharp end of the pin is pointed downward. It is fair to assume that the point has probably impinged on or perforated the intestinal wall on account of its stationary position for the past five days.

A physical examination of the abdomen reveals a mild degree of sensibility, but very little spasm or rigidity. The patient has been afebrile, but has had a persistent pulse-rate of 100 to 110. We believe that the patient's future will be made safer by an exploratory laparotomy and the removal of this foreign body than by trusting to nature to pass it.

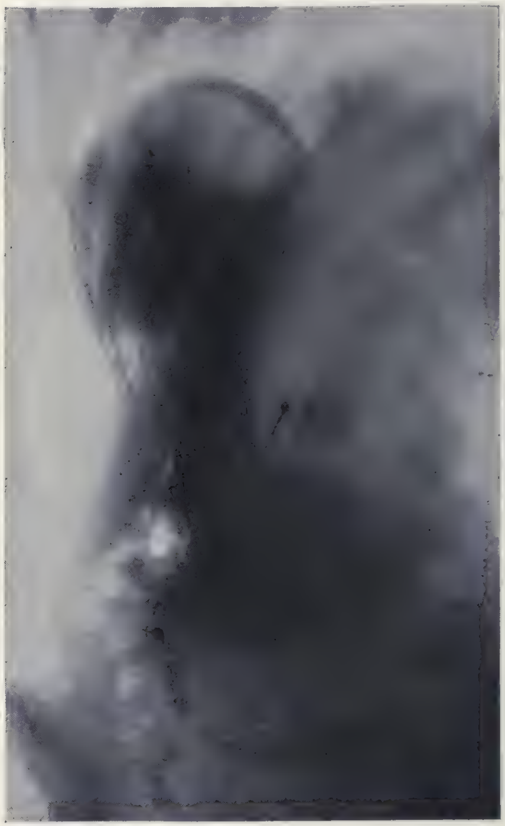

Fig. 220.—Swallowing of small hat-pin.

Operation: Incision.—We will make our incision parallel to the midline, about 4 inches long, 1 inch to the right of the median line, and with the navel on a level with the center of the incision.

The omentum and transverse colon are lifted upward and to the left, exposing the mesocolon. We can see here the beginning of the small intestine. Upon running the right hand down to the duodenojejunal flexure we feel the sharp end of the pin which is perforating the jejunum about 1 cm. from the angle. We will place a hemostat on the free end of the pin and carefully pull the

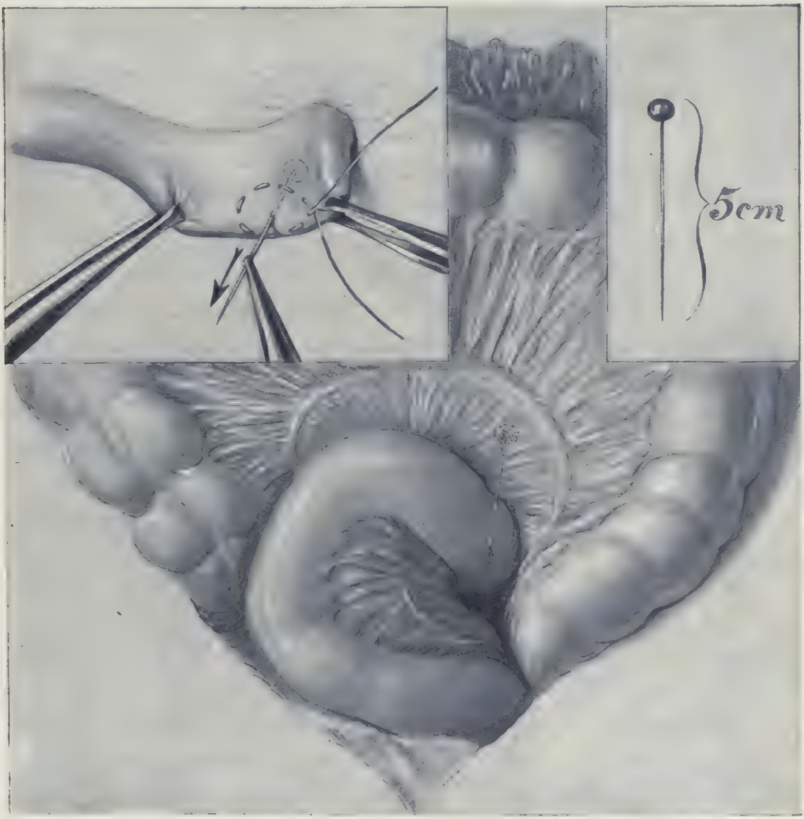

Fig. 221.—Pin in jejunum, 1 cm. of the extremity of the pin perforating the jejunum a short distance beyond the duodenojejunal flexure. *Inserts.*—Left: Purse string previous to withdrawing of pin; right, actual size of pin.

pin out until the beaded extremity is held taut within the lumen of the gut. With the pin firmly grasped we can now wall off our area with laparotomy pads, and upon separating the coils of the small intestine and the jejunum we find a small amount of plastic exudate about the area of the angle of Treitz. The perforation has not been of long standing, but is comparatively recent. You notice the hypervascularity of the mesentery and the mesocolon. With our field adequately walled off the pin is held upright and bears a resemblance not unlike the appendix to the cecum. A purse-string suture will now be run around the area represented by the beaded end of the pin much after the fashion of a purse-string in an appendectomy. With this purse-string a loop is held by the little finger of the left hand while the two free ends are held between the thumb and first finger. We shall forcibly pull out the pin, and then invert the aperture made upon removing the pin by means of the purse-string suture, and so make an absolutely hermetic closure (Fig. 221).

I do not believe that the slight kinking from the suture will in any way affect the function of the jejunum. The plastic exudate is left *in situ* and the toilette of the peritoneum completed. In view of the relative lack of infectivity of the contents of the jejunum we will close the abdomen without drainage.

Postoperative Treatment.—The patient will be given the routine treatment for peritonitis: (1) Nothing by mouth, (2) slight Fowler position, (3) Murphy proctoclysis, and (4) morphin sufficient to keep the patient quiet and free from restlessness.

After-result.—Patient was dressed on the fifth and eighth day after operation and discharged from the hospital on the ninth day after operation. Wound in excellent condition.

ACUTE APPENDICITIS; PERFORATION; APPENDECTOMY

Mistakes Made in the Diagnosis of Acute Appendicitis. The Definite Onset of Symptoms and Their Chronologic Sequence. The Causes of Death after Appendectomy. Necessity for Varied Operative Technic Depending on Pathologic Conditions Found. The Importance of Wise and Thoughtful Postoperative Treatment.

History.—The patient I am presenting this afternoon is twenty-four years of age, a tailor, born in Russia, and has resided in the United States for the past eight years. He enters the Post-Graduate Hospital complaining of pain in the right lower quadrant, duration twenty-four hours. The patient states that eighteen hours ago he was seized with a sudden, severe pain, which came on suddenly, was of cramplike character, and confined more or less to the entire abdomen. The pain was quite severe, was associated with restlessness, and at the onset he took "Elax" and vomited soon afterward. This morning the patient took a dose of Epsom salts, which was followed by vomiting. Some time during the night the pain became localized to the right lower quadrant, was of constant character, and has remained unabated up to the present time. Temperature by mouth 99.8° F., pulse 110, respirations 30. A physical examination reveals a uniformly rigid abdomen, respirations of the costal type, with complete immobility of the lower half of the abdomen. The patient is able to focalize his pain with the tip of the index-finger of the right hand to a point 1 inch to the right of the navel and 2 inches below. Upon repeated attempts his localization of maximum pain is very accurate. There is muscle spasm, muscle rigidity, and extreme tenderness over the region of McBurney's point. The pupils react to light and accommodation. The knee-jerks are equal and active.

An emergency blood examination shows 17,400 leukocytes, 85 per cent. of which are polynuclears. Examination of the urine is negative for pathologic elements.

The patient presents a definite sequence of symptomatology, and his symptoms are exhibited in a definite chronologic order. These symptoms are so constant in their essential features as to make an almost uniformly clinical picture of acute appendicitis.

Murphy many years ago emphasized in the most emphatic manner that the chronologic sequence of symptoms of acute appendicitis was practically an unvarying clinical picture.

An analysis of this man's history shows that in the very beginning of his illness he was seized suddenly with pain. There were certain essential features about this pain in regard to locality, mode of onset, character, distribution, and association with other symptoms that are quite distinctive. The pain was of a cramplike, colicky character, was diffused over the area of the epigastrium and navel. The pain came on in paroxysms of great intensity, and yet while suffering intense pain the patient was restless and his suffering was somewhat benefited by movement. This colic was followed by vomiting, possibly brought on by his cathartic, but in any event there would ordinarily follow a sensation of nausea or vomiting, or both. At the end of eighteen hours the patient had a temperature of 99.8° F., pulse 110, and a pain in the right lower quadrant. The original pain has become constant, has lost its colicky character and is associated with abdominal rigidity, spasm, and with a focalized point of tenderness that can be accurately determined with the index-finger of the patient's right hand. In addition, he shows a definite pyogenic blood reaction in leukocytosis and polynucleosis. In view of the patient's marked peritoneal reaction, his intense rigidity, and spasm, we are justified in making the diagnosis of suppurative and possibly perforative appendicitis with localized exudation and peri-appendicitis.

After obtaining the confidence of the patient, if one places the right hand over the lower abdomen and the patient is encouraged to breathe, it is possible to detect a mass that moves slightly on full inspiration and descends beneath the right hand not unlike the roll of a billiard ball. From this we assume that there is a peri-appendicitis and that the chief guardian of peritoneal infections, the omentum, is doing duty as a protective barrier.

Discussion.—The evolution of acute appendicitis is so definite that it should be one of the acute abdominal inflammations, easy of diagnosis, and with early surgical intervention without mortality. Yet the records of all general hospitals show a death-rate varying from 4 to 6 per cent. These deaths are directly due to failure to diagnose the condition early or failure to recognize its gravity. Surgical postponement and medical procrastination are not infrequently a factor in mortality as well as incorrect or faulty postoperative treatment.

Acute appendicitis has a very definite sequence of symptoms which in their essential character are practically constant and uniform because they are the expression of a very definite pathology. It is only necessary to recall some of the anatomic features of the appendical region and the appendix to understand why acute appendicitis has such a very definite pathologic sequence. The appendix represents a blind tube, and in the adult has the narrowest portion of its lumen at the cecal juncture and known as the valve of Gerlach. It has a strong elastic submucous layer which for a considerable length of time retains the products of infection within the lumen. This elastic submucosa is absent in the appendix of a child and accounts for the variability in the symptomatology of acute appendicitis in children and the marked proneness for the appendix to perforate with extravasation of intestinal contents into the peritoneal cavity. In the appendix and adjacent cecum there is a predominant development of lymphoid tissue which probably represents a protective agency against infection. The arteries of the appendix are essentially terminal, therefore the circulation is rather precarious in the presence of infection and edema. One of the nice points of controversial literature in regard to acute appendicitis is whether perforation precedes thrombosis or thrombosis precedes perforation.

In about 14 per cent. of female subjects there is an accessory artery connected with the right ovary, and the causal relationship of menstruation with acute appendicitis has been observed many times. The deficiency of the serosa at the mesentery of the appendix renders the appendix most susceptible to perforation at that point. Infection may be said to begin uniformly on the mucosa with the production of turgescence and inflammatory edema. This tumefaction ensues very early and rapidly brings about an occlusion either at the cecal extremity or at some point of angulation of the appendix, and there is an immediate stoppage of intracecal drainage. There follows hemorrhagic infiltration with leukocytic invasion, and the lumen of the appendix becomes distended with pus and feculent material. This condition is essentially an empyema, and the products of an infection are retained under pressure, which means both local and systemic reaction. The symptoms very definitely parallel the pathologic changes, and it is possible to correlate and interpret the pathology by the course and sequence of the symptoms. (See Chart I.)

The initial stage of acute appendicitis represents an infection and irritation within the appendix, and as a result the entire small intestine participates in hyperactivity and hyperperistalsis. The pain, therefore, is colicky in character, of maximum intensity, intermittent, and referred to the zone of the umbilicus. Hyperactivity of the small intestine is followed as a rule by a sensation of nausea or vomiting, or both, and since the mechanical factor producing the pain is hyperperistalsis of the small intestine, we have generalized abdominal sensibility. Infection and its systemic reaction manifests itself in fever and leukocytosis. During the second twenty-four hours one of three processes takes place: (1) drainage of the appendicular contents back into the cecum, (2) gangrene, or (3) perforation. When either of the latter two eventuate the entire clinical picture is changed, and we have a localized abscess in the right lower quadrant from periappendical inflammation and exudation. At this stage the pain is not colicky, but constant in character, with localized tenderness, spasm, and rigidity, with paralysis of the intestines in the attempt to splint or wall off the inflammatory process. The entire picture then becomes one of localized intraperitoneal abscess.

CHART I

SYMPTOMATOLOGY OF ACUTE APPENDICITIS

Evolution of Symptoms Paralleling Progressive Pathologic Changes in the Appendix

First twenty-four hours.	Twenty-four to forty-eight hours.	Forty-eight to seventy-two hours.
1. Pain: Colicky, Epigastric, Intermittent.	1. Pain: Not colicky, Confined to R. L. Q., Constant.	1. Pain: Not colicky, Confined to R. L. Q., Constant.
2. Nausea or vomiting, or both.	2. Rarely vomiting.	2. Vomiting usually absent.
3. Generalized abdominal sensitiveness.	3. Tenderness in R. L. Q., Spasticity.	3. Tenderness in R. L. Q., Spasticity.
4. Temperature +.	4. Temperature 101°–103° F.	4. Temperature normal to 104° F.
5. Leukocytosis and polynucleosis.	5. Leukocytosis, increasing polynucleosis.	5. Leukocytosis and polynucleosis.
		6. Tumor or induration.

Acute appendicitis provides us with some very interesting blood counts, and the latter within certain limits offers a diagnostic aid and a prognostic agent of no mean value. In interpreting leukocytic reactions to acute infections we must have in mind a basic standard, and accordingly, we assume that the greatest number of leukocytes that may exist in any normal condition is not in excess of 10,000 per c.mm., and that the greatest number of polynuclear cells present in any condition of health does not exceed 75 per cent. We may take the total count as an index of a patient's resistance to infection, and we may take the percentage polynuclear count as an index of the virulence or severity of the infection.

Gibson a number of years ago devised a chart to portray graphically this relationship between polynuclear percentage and leukocytosis. Under conditions of normal resistance in inflammatory lesions which are well borne the polynuclears are increased 1 per cent. for every addition of 1000 to the gross leukocyte count. This can be indicated schematically:

CHART II

Gross leukocyte count per c.mm.	Percentage of polynuclears.
10,000	75
15,000	80
20,000	85
25,000	90
30,000	95
40,000	100

Under normal conditions of health the white cells are uniformly distributed throughout the body—in the connective tissue and in the circulation. Sondern, analyzing the blood counts in a large series of cases of acute appendicitis, was able to catalogue the results into three groups, and to deduce certain pathologic conditions from the general grouping of the leukocytes and polynuclears. Sondern's grouping may be stated briefly as follows: group 1, leukocytosis of any degree and a polynuclear count below 70 per cent. would exclude gangrene or pus; group 2, a leukocytosis of slight degree and a polynuclear count over 80 per cent. would indicate rather severe infection with slight resistance; group 3, a large leukocyte count and a polynuclear count over 85 per cent. would seem to suggest the presence of gangrene or pus.

In this patient we have made the diagnosis of acute appendicitis, and we find that he has a gross leukocyte count of 17,400, which points to a fair degree of resistance upon the part of the body, and a polynuclear percentage of 85, which points to a rather virulent infection, which makes the presence of pus or gangrene probable.

Operation: Incision.—The incision that we use in doing an appendectomy begins about 1 inch below the level of the navel and 1 inch to the right of the median line and extends downward 3½ to 4 inches, curving slightly inward toward the median line. The anterior sheath of the rectus muscle is divided and the rectus muscle itself is split in the longitudinal direction. Occasionally we injure the veins accompanying the deep epigastric artery, but if one recalls that these vessels are in the properitoneal fat they can be displaced to one side by gently wiping the fat with a piece of gauze and so lessen the possibility of injury to them. Great care is taken in entering the peritoneal cavity on account of the possibility of injury to the intestines lying beneath. We find the omentum lying beneath the incision and enclosing the cecum very much as the palm of the hand would enclose a billiard ball, and representing a protective barrier against the spread of infection. We proceed to separate the omentum and find some free lymph-like material. This fluid is not ordinarily infectious. Quite the contrary, it is a reactive fluid, an exudate from the peritoneum, and is essentially a protective product. It is found quite early in the more severe cases of infected appendices.

We find that the appendix is ruptured on its mesenteric border and there has been an extravasation of intestinal contents. We see escaping from the mass a few drams of creamy, yellow pus of a distinctly colonic odor. Upon continuing the separation of the omentum we see that the appendix has participated in an acute inflammatory process with perforation at about the midpoint. The proximal portion is edematous and swollen, but still capable of being inverted. The meso-appendix is very carefully ligated, extreme care being necessary on account of the infiltrated character of the meso-appendix. Close to the cecum the appendix is crushed with a hemostat, and in the crushed area the appendix is ligated with No. 2 chromic catgut. The effect of the crushing of the appendix is to destroy the mucosa and so more readily close off the lumen of the appendix after it is inverted.

We now begin our purse-string suture of Pagenstecher thread at a point directly opposite to us. The passing of the purse-string stitch may be made more intelligible by taking the caput of the cecum as the dial of a watch, and we begin our purse-string at what corresponds to 12 o'clock and penetrate the serosa of the cecum at 10, 8, and 6. At 6 o'clock a small loop is left free and the purse-string continued up at 4 and 2, and finally again at 12. The two free ends of the purse-string are tied with a single knot which is run down close to the cecum and which represent the beginning and ending of the purse-string loop. These two ends are grasped in the thumb and first finger of the left hand and the loop is placed over the little finger. A piece of gauze is now laid under the appendix, and then distal to the crushed, ligated area of the appendix a hemostat is placed to keep the contents of the appendix from running free upon cutting. Between this clamp and the ligature the appendix is divided and the gauze, clamp, and appendix removed in one piece. The tip of the stump of the appendix is freely touched with pure phenol on a cotton applicator, and using the other end of the applicator the stump of the appendix is pushed into the center of the purse-string. When the stump has clearly disappeared beneath the level of the cecum the loop on the little finger is released and upon pulling the two ends of the ligature between the thumb and first finger the stump is completely inverted within the infolding peritoneum of the cecum. (See Figs. 210–217.)

On account of the free pus in the right lower quadrant of this patient's abdomen it will be necessary for us to introduce a rubber tissue drain down to the area of greatest inflammatory reaction. If the patient's pulse remits, temperature drops, the drain may be removed at the end of thirty-six hours, and should make very little difference in the ordinary healing of his wound.

Postoperative Treatment.—Death in acute perforative appendicitis is not infrequently due to faulty or incorrect after-treatment.

If you consider that the surface area of the peritonuem equals that of the surface area of the body, and that the peritoneum is capable of absorbing about 5 per cent. of the body weight in an hour, we can understand the tremendous additional absorptive power of an abraded, injured, inflamed, or infected peritoneum. It has been found that the rate of absorption within the abdominal cavity varies with the anatomic location. Absorption is most rapid in the area of the diaphragm, less so by the omentum, by the visceral peritoneum, by the parietal peritoneum, and least by the pelvic peritoneum.

The guiding principle of our postoperative treatment in acute peritoneal infections is to prevent a local peritonitis from becoming general and to employ all measures that will diminish the rate of peritoneal absorption. We may therefore define a routine postoperative treatment embracing the following: (1) Adequate surgical intervention and drainage of the area of infection; (2) nothing by mouth, not even water; (3) Fowler position—at least an elevation of 30 to 35 degrees; (4) the introduction of ordinary tap-water by Murphy proctoclysis; (5) maintaining an empty stomach, employing gastric lavage if necessary; (6) to control restlessness or pain by the use of morphin.

We no longer employ the normal saline solution for proctoclysis because it has been conclusively demonstrated that the saline has no advantage over the ordinary tap-water and has many distinct disadvantages. A patient can absorb plain water over a longer period of time, with less rectal irritation; can take more plain water with less thirst after the termination of the proctoclysis; has less nausea with plain water than follows proctoclysis with normal saline. One has only to recall the cases that have exhibited edema of the eyes and legs and the occasional acute edema of the lungs that have followed the use of too long-continued proctoclysis of normal saline to see the advantage of plain water over normal saline solution.

One of the most important signs of diminishing peritoneal reaction is the falling pulse-rate, and when the pulse-rate declines to 100 or less we have considered it reasonably safe to give fluids in small quantities by mouth. We refrain from giving cathartics by mouth for a longer period of time, contenting ourselves with cleansing the lower bowel daily with an enema of not more than 700 to 1000 c.c.

After-results.—The patient was dressed at the end of forty-eight hours and the rubber tissue drain removed. His temperature dropped to normal at the end of the third day, when he was placed upon soft diet. His wound and subsequent convalescence were uneventful and he was discharged from the hospital on the afternoon of the thirteenth day.

CLINIC OF DR. BYRON STOOKEY

Neurological Institute

BRACHIAL PLEXUS INJURIES

Rupture of the brachial plexus occurs not only in infants during childbirth, but in adults as well. In both the injury is the result of mechanical forces similarly applied, and both show similar pathologic lesions in the nerve trunks of the plexus as well as similar paralyses. Stab wounds and gunshot wounds, while less frequent, are not uncommon, since the plexus is in a relatively exposed position in the posterior triangle of the neck, and does not receive the protection usually afforded structures of such importance.

In lesions so readily demonstrable as those found in obstetric paralysis it seems strange that there should be two opposed views concerning the pathologic changes encountered, some claiming that the deformity is primarily bony, involving the shoulder-joint; others, that the injury is primarily to the nerve roots which form the brachial plexus. As the result of these two variant opinions an attitude of *laissez faire* has been adopted, and often nothing is done for the infant. Generally the mother is told that the paralysis will disappear in time. No doubt a few of the lesser injuries recover untreated, yet the more severe do not.

Depending upon the exact location of the injury, great variation in the paralyses will be found because of the anatomic complexity of the brachial plexus, consequently, a thorough knowledge of the plexus and a minute examination are required if an accurate localization is to be made. We shall attempt to reach an accurate localization in these 2 cases of brachial plexus injuries—one a stab wound and the other an obstetric paralysis.

CASE I. STAB WOUND OF THE BRACHIAL PLEXUS

The first case I wish to show is a negro, twenty-five years old, who was stabbed in the left supraclavicular region in a "social" quarrel over a colored girl. The patient states that without warning, as he attempted to pass his rival on the stairs, the latter suddenly stabbed him with a knife. The negro asserts that the knife was "at least 8 inches long." The knife entered the neck on the left side about 3 cm. above the clavicle, and immediately the left arm fell limp, with tingling in all five fingers. There was considerable bleeding, and the patient was taken to an emergency hospital, where the wound was dressed. No surgical interference was undertaken. The patient's arm was placed in a sling, and he reported for daily dressings to the outpatient department for a period of about three weeks.

During this period of three weeks his arm was carried in a sling and no other mechanical treatment was given. The patient was told that in a few weeks more he would regain the use of his arm.

The injury to this patient occurred two months ago. Judging from the history of immediate paralysis and what we still find, there has been no improvement in his condition. He is unable to raise or to bend his arm, though he says his grasp, now as always, is good. During the past few weeks there has been some pain radiating down the other side of the arm and in the region of the scar. The pain is made worse by any movement which causes pressure upon the scar, such pressure producing exquisite pain both locally at the site pressed and in the arm. During the past two months the patient has been receiving massage and faradic electricity, which he does not think has caused any change in his condition. He was referred three days ago for a neurosurgical opinion as to whether or not an operation was indicated.

Before beginning the examination there are one or two points in the history to which it might be well to call attention. In the first place, any stab wound such as this, obviously involving the nerves of an extremity, giving an immediate and complete flaccid paralysis of one or more of the nerves or nerve roots, should be *explored* at the time of repair of the primary wound. If at this time the nerves are found to be severed or partially severed, repair of the nerves should be undertaken at once. Such repair, when done at the primary operation, is called primary suture.

End-results of primary nerve suture are better than those of secondary suture.

On the other hand, if the nerves are found in anatomic continuity, even though they may appear traumatized, the *most rigid conservatism* is demanded. Such nerves at *primary exposure* should be left undisturbed. No surgeon, however careful or skilful, is able to reunite two nerve ends without some loss or dispersion of the neuraxes in the paths of the nerve trunk. At primary operation in these cases a careful toilet of the field should be made, and the surrounding tissues repaired so as to minimize scar formation and, as far as possible, prevent scar invasion of the traumatized nerve trunks, in this manner facilitating nerve repair. In this case, even though an obvious injury of the brachial plexus was indicated, not only by the paralysis but by the site of the injury—namely, the posterior triangle of the neck immediately over the plexus—nothing was done to investigate the plexus or repair the nerve injury.

The second point in the history to which I wish to call your attention is the fact that though there was a recognized paralysis, no adequate splinting was given to the patient in order to relax the paralyzed muscles. Mechanical support of paralyzed muscles is an axiom in the treatment of nerve injuries. In order for a splint to be effective it should overcome all deformities, or at least the principal ones. It should prevent contractures of the opposing muscles, afford relaxation of those paralyzed, and yet not cause fixation. Concerning the proper mechanical treatment we will speak again later.

Examination.—As you well know, the examination of nerve injuries is necessarily long, and requires thorough investigation of many details, not only of the local injury but also the motor paralysis, the electric changes, and the alteration in the sensation of the affected part. Unless such an examination is complete, neither exact localization of the injury is possible nor its extent, nor whether or not recovery has begun. These are all important points. It would be obviously unwise to operate when regeneration is progressing; or, on the other hand, to operate at a level at which there is no injury to the nerve. Generally speaking, neither the motor nor the sensory examination alone suffices, but both should be made in order to interpret accurately.

Local Examination.—We see here at the posterior triangle of the neck a scar, rather wide for a stab wound—about 3 x 5 cm.—having obviously been the site of former suppuration. The scar is deeply adherent and is not freely movable, being apparently adherent to the tissues within the depth. It would appear that the scar extends inward approximately 3 to 4 cm.; this is a thin individual, and this depth is sufficient to involve the upper cords of the brachial plexus. We notice that the patient winces each time the scar is handled, and the pain, he tells us, is not only local at the site of pressure, but is referred down the arm, especially on the outer side of the arm. The scar seems dense and no pulsation or thrill is felt. While the injury is a little higher than the arch of the subclavian, it is always well to consider in this region a traumatic arterial aneurysm. By auscultation nothing is made out, and this is further confirmed by comparing the blood-pressure of both the right and left arms. In each instance the record shows us the systolic to be 130 and the diastolic 90. Absence of a palpable thrill, of characteristic bruit, as well as equality of blood-pressure in both sides make aneurysm improbable.

Here, then, is a local wound which from the history we may infer involves some part of the brachial plexus. Furthermore, the wound is so placed as to be over at least the upper two roots, and the referred pain on the outer side of the arm would seem to indicate their implication.

Motor Examination.—Let us see what movements the patient is unable to accomplish. We notice that he cannot flex the forearm upon the arm; he is unable to elevate the arm in either the lateral or the frontal plane. Adduction, on the other hand, is apparently normal, as is also internal rotation, while true external rotation is not accomplished at all. The external rotation, you see, is, in reality, a pseudosupination. Apparently flexion and extension of the fingers and wrist are unimpaired, as are also the movements of the fingers. Thus we have seen the total movements which the patient can perform.

The information thus gained may be of immense value providing you are familiar with each movement and the component muscles involved in each phase of any such total movement. However, the only reliable motor information is gained not from total movements, but from a study of the action of *each individual muscle*. The action of any one muscle may drop out, and yet a total movement may be performed either by the remaining muscles of the group or by the action of new muscular combinations. This Létiévant (1872) termed "mouvements supplées." A great variety of such movements were described by him, and of such movements we must be aware if we wish to place reliance upon the information given by total movements.

Individual Muscle Action.—We will now try out the motor function of each individual muscle of this extremity. We will begin with the deltoid. The patient is unable to elevate the arm in abduction more than is done by the action of the scapula which, in attempting to co-operate in the elevation of the arm, undergoes rotation. This rotation of the scapula occurs as the initial movement in elevation of the humerus, and it is to this rotation of the scapula that the slight abduction of the humerus which you see here must be attributed. The patient is unable to elevate the humerus further, and the hand palpating the deltoid finds it flat and flaccid, without any appreciable trace of contraction.

It is interesting to note in this connection that the usual text-book description of the action of the deltoid is not that which we now understand this muscle to have. In elevation of the humerus there are really two component cycles of movement: (1) rotation of the scapula and (2) elevation of the humerus. We are taught that the deltoid elevates the humerus to a right angle, but this is not really the case. In elevation of the humerus, first rotation of the scapula occurs, approximately

5 or 6 degrees. Following this, the deltoid elevates the humerus to about 60 degrees; and *from 60 to 115 degrees elevation is accomplished principally by the action of the scapular muscles;* following which, elevation is completed to 180 degrees, that is, to the vertical position by *active participation of the deltoid*, especially the clavicular head. This action of the deltoid in the elevation of the humerus from 115 to 180 degrees has heretofore been ignored, although it is a very important part of its function.

We will now test adduction. As the patient attempts to draw the arm inward toward the body we offer resistance and at the same time palpate the tendons of the teres major and the pectoralis major. These contract and appear to be normal. The patient now attempts to draw the arm inward and forward across the chest, thus testing further the action of the pectoralis major. This movement is readily accomplished, and the pectoralis major, you notice, is definitely contracted; but if you are careful in your examination you will see that the clavicular head of this muscle does not participate—only the sternal portion is contracted, the clavicular being flaccid and apparently atrophic. *The clavicular head* of the pectoralis major is paralyzed.

We will now test the external rotators, namely, the supraspinatus and infraspinatus. Neither of these muscles contracts and no true external rotation takes place. We notice the hollow both above and below the spine of the scapula, which indicates their atrophy.

Next, we will test the biceps. Flexion of the forearm is impossible and, as you see, this muscle belly remains flabby. It is completely paralyzed, is atrophied, and has lost its tone.

We will next test the supinator longus. This muscle is poorly named, for it is very little a supinator and very much a flexor of the forearm. If in a normal individual the forearm is held semiflexed and the patient is told to continue flexion, this muscle will rise as a distinct band, forming the lateral boundary of the elbow. In this case no such muscular band is made out, and the semiflexed elbow is seen to be without its usual lateral boundary, nor does any flexion take place. The supinator longus is paralyzed. I have seen excellent men fail to recognize a biceps paralysis because the patient was able to flex the forearm sufficiently well upon the arm by means of the supinator longus without the loss of the biceps action being detected. This flexion action of the supinator longus must not be forgotten.

Next we will try the triceps. Here extension of the forearm is performed, but there is some obvious weakness, particularly noted by comparison with the sound side. The coracobrachialis muscle can be made to contract and palpated by having the patient attempt to raise the arm into the gun position. While this position cannot be accomplished in this patient, due to paralysis of other muscles, contraction of the coracobrachialis can be distinctly made out.

In the forearm: The flexors of the wrist on both the radial and the ulnar side are distinctly felt; especially are they made out over their tendons at the wrist, where with some practice most of them may be fairly accurately identified. The flexor carpi ulnaris shows normal contraction, and the action of the palmaris longus is readily demonstrable.

We note then, in summarizing our motor findings, paralysis of the following muscles: Deltoid, clavicular head of the pectoralis major, supraspinatus, infraspinatus, biceps, supinator longus, and weakness of the triceps.

Obviously such an extensive lesion cannot be explained by injury to any one peripheral nerve, nor can it be attributed to a lesion of the secondary cords. The site of an injury involving such a distribution—including as it does muscles supplied by the suprascapular nerve, the external anterior thoracic, the musculocutaneous, the circumflex, and *part* of the musculospiral—can only be accounted for by some injury to the brachial plexus proximal to the formation of the secondary cords. Injury to any peripheral nerve would involve only muscles in the distribution of that nerve; injury to any of the secondary cords—unless nearly all are involved—would generally show a distribution corresponding to two or more nerves, while this distribution corresponds to five. Furthermore, a lesion of the secondary cords could not explain paralysis of the clavicular head of the pectoralis major or paralysis of the supra- and infraspinatus, since the nerve supply of these last two muscles comes off the brachial plexus before the formation of the primary outer cord, or immediately at the junction of the fifth and sixth cervical roots.

Thus, considering the information given by the local examination of the site of the injury and the motor distribution of the paralysis, the lesion in this case must be placed in the fifth and sixth cervical nerve roots proximal to the point, or at the point at which the suprascapular nerve is given off. The lesion does not extend to the seventh root, since the coracobrachialis muscle is not paralyzed. This muscle, you will recall, is supplied by a separate nerve, the nerve to the coracobrachialis muscle, which arises from the seventh cervical and passes *along* the musculocutaneous nerve to the coracobrachialis; the musculocutaneous nerve, on the other hand, arises from the fifth and sixth cervical, while the nerve to the coracobrachialis which accompanies it arises from the seventh cervical.

The lesion in this case, however, is not complete, that is, the anatomic continuity of the fifth and sixth roots has not been interrupted, since certain muscles completely or partially supplied, though not invariably, through the fifth and sixth are not paralyzed nor is there any weakness in them. They are the palmaris longus, the flexor carpi radialis, and sometimes the superficial muscles of the thenar group.

Electric Examination.—This has already been made, and the report shows that there is no faradic response in the muscles which we have already designated as paralyzed. There is no reaction of degeneration.

This information confirms the motor examination. However, it must be recalled that frequently a muscle which has regained its power of contraction following paralysis may not show a return of faradic irritability until long after return of voluntary motion.

In spite of the information already gained, the examination of this case is not complete until a sensory investigation has been made. Here is the chart of the sensory changes found in this patient (Fig. 222). There are two lines, an outer and an inner. Both lie over the deltoid, but do not completely overlie the deltoid area. The outer line indicates the loss to cotton wool, while the inner and smaller area shows the loss to extreme degrees of temperature and to pin prick. The area you see outlined is the only one in which any anesthesia has been found. None was made out below the elbow corresponding to the sixth root distribution. This area, you see, does not correspond to the area supplied by the circumflex nerve, in that it is very much smaller than the usual cutaneous distribution of this nerve. The circumflex nerve arises from the posterior divisions of the fifth and sixth, and contains sensory fibers from both, though mainly from the sixth. Since this area does not correspond to the circumflex, but more to the contribution in the circumflex

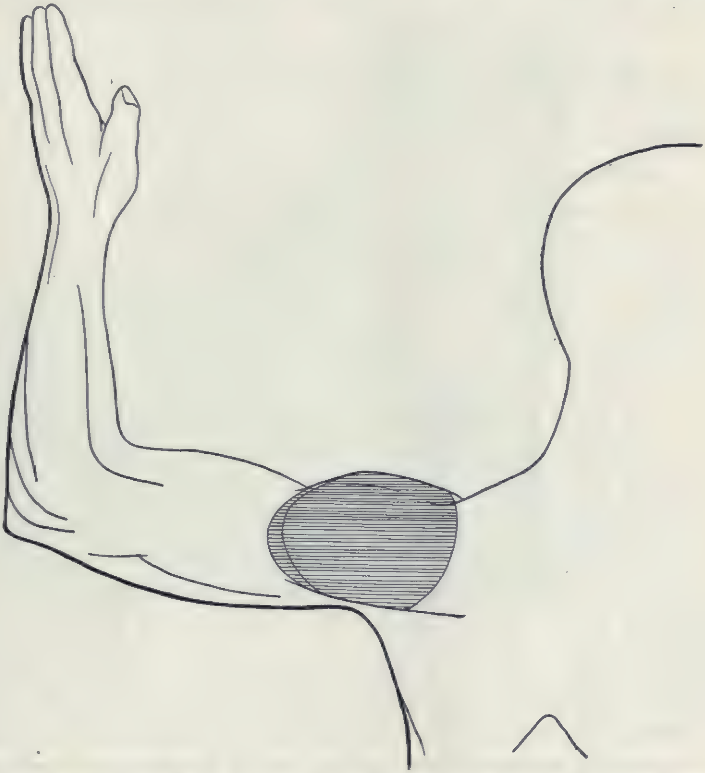

Fig. 222.—Chart showing loss of sensation as found in Case I. This area corresponds approximately to the distribution of the fifth cervical root.

of the fifth cervical root, we may infer that some fibers of the sixth cervical root remain uninjured, especially since no changes were found in the area belonging to the sixth root.

Thus the sensory findings substantiate the conclusion reached in the motor examination, namely, that the lesion of the fifth and sixth cervical roots is not complete and involves mainly the fifth. Further evidence of the incompleteness of the lesion is found in the referred pain which is elicited by pressure over the scar. The patient outlines consistently an area of referred pain which roughtly corresponds to the sixth distribution. Referred pain of this character is not found in complete nerve lesions.

Our diagnosis, then, is an incomplete lesion of the brachial plexus involving the fifth and sixth cervical roots, proximal to or at the point at which the suprascapular nerve is given off.

Judging by our examination of the local injury, it is only fair to assume that the roots are involved in the deeper portion of the scar which we here see superficially.

Operation.—A longitudinal incision 4 inches long is made over the site of the injury. A longitudinal incision is made so as to permit of a more extensive exposure of the plexus, if such is called for. I am now excising the superficial scar so as to exclude it from the line of closure. Scar tissue delays primary union and is apt to slough. As I dissect further, a small muscle belly is seen running transversely across the field. This is the posterior belly of the omohyoid. This muscle is now pulled aside and the transverse cervical artery and vein are exposed. We pass a ligature around each and cut both artery and vein. I am now passing two sutures through the omohyoid and shall cut between them. These sutures serve as hemostatic muscle sutures, preventing bleeding from the cut muscle ends. The muscle is now cut transversely, and these two sutures will be used to reunite the muscle when closing the wound. I can now identify the scalenius anticus and scalenius medius muscles. Between these the plexus should lie (Fig. 223).

As I clear away the fascia the upper cord presents. I am working above the site of the injury. It is always better to isolate the structures either above or below, and then dissect down through the scar. As I dissect deeper, the sixth cervical cord is seen. I have my finger on it. The scar is at the union of the fifth and sixth roots. I am dissecting laterally now to find the suprascapular nerve so as to trace it inward through the scar and thus avoid damaging it, as I might do if I hunted for it in the scar. Here is the suprascapular nerve. As I dissect it to its origin, it is seen involved in the scar. I am now dissecting the scar tissue from the nerve trunks. The fifth root is more involved than the sixth. The fifth is somewhat contracted by the scar, though anatomic continuity is not broken. The suprascapular nerve is more damaged than the fifth root, and the fifth more than the sixth. This is tedious dissection. Each stroke is most cau-

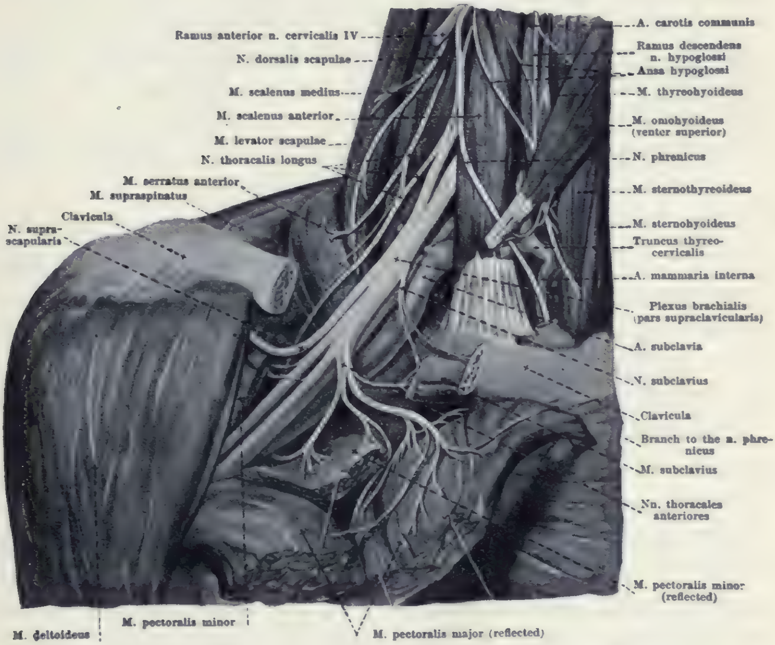

Fig. 223.—Right plexus brachialis with its short branches, viewed from in front. The sternocleidomastoideus and trapezius muscles have been completely, and the omohyoideus and subclavius muscles partially, removed; a piece has been sawn out of the clavicle; the pectorales muscles have been incised and reflected (Spalteholtz).

tiously done. Speed is not an asset at such times. Care must be taken to injure as little as possible; the nerve trunks must not be handled.

The scar is now free from both the ventral and lateral aspects of the fifth and sixth roots. We shall now test with the electrode. Slight response is obtained in the biceps; none in the deltoid. With the patient lying on his back, it is difficult to determine if there is any response in the supra- and infraspinatii muscles. In view of the recent injury (two months old) and the anatomic picture we have here, it is best to be conservative. We will inject salt solution under pressure into the nerve trunk, thus freeing the individual funiculi. This is called internal neurolysis.

The field is cleared of scar as much as possible; where we have not been able to excise, we have infolded it upon itself. In some instances this is better than excision. Due to the localization of the injury, namely, in the neck, where in this man there is little or no fatty tissue to serve as a fat pedicle to transplant in order to wall off the scar, we shall surround the nerve with Huber's cargile membrane. A free fatty transplant serves only to increase scar and should not be employed. Huber's membrane is ordinary Cargile treated with alcohol. Huber, Professor of Anatomy at the University of Michigan, found that such membrane remains in the tissues five or six months without being absorbed, and that it is borne well by the tissues without causing any increase of scar; whereas ordinary membrane is readily absorbed, remaining in the tissues about as long as catgut. Huber's Cargile membrane, I believe, has a great field of usefulness not only in neurosurgery, but in other fields as well.

Had I done nerve suture and thus removed the injured portion of the nerve, no form of protection at the line of union would be necessary. The field is now dry—this is a very essential point—and we are now closing the wound in layers. Dressing is applied, and we are now ready to put on the splint, which has already been made and fitted to the individual (Fig. 224).

This splint aims to overcome the deformity which results from this injury. The arm is abducted above a right angle in order to relax the deltoid; the forearm is slightly flexed and held in external rotation, thus relaxing the biceps and supinator longus, and the arm is held in external rotation, overcoming the tendency to contraction of the internal rotators. The arm will be held essentially in this position until some evidence of regeneration has shown itself.

We have done nerve liberation and not nerve suture. If no improvement is shown within two months after nerve liberation, this generally means that nerve suture should have been done instead of liberation. However, since there is no way of determining with certainty which should be done, we can only rely upon our own judgment—the result of seeing a great many such conditions—and, now that we know the condition of the nerves, wait two months for some evidence of regeneration. This can be done without any great injury to the patient. If our judgment has been correct, we will have saved him a year, since regeneration following suture can hardly be expected in less time. In the meanwhile we shall see that massage and galvanic current are given, and that neither contractures nor overstretching of the paralyzed muscles occur.

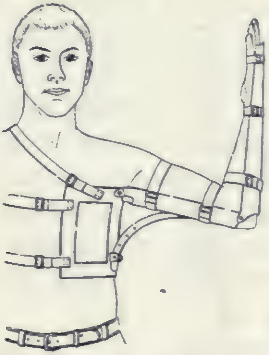

Fig. 224.—Adjustable abduction splint with adjustable forearm piece for paralysis of the fifth and sixth cervical nerves. The arm is held in abduction and *external rotation* with the hand in supination. By altering the pin and lever to the arm-piece, the arm can be held in any desired angle of abduction. Forearm piece may also be adjusted by screw lock to various degrees of flexion. The splint is made of aluminum and lined with felt.

Note.—The patient left the hospital in ten days. The wound healed by first intention. Four weeks after operation some evidence of regeneration was seen, and in four months function had returned in all the muscles except the supra- and infraspinatii. A second operation will be done on the suprascapular nerve to try to obtain innervation of the external rotators.

CASE II.

This is an infant, two years old. Normal labor; no instruments; head presentation. Since birth it has been unable to use its left arm. The fingers move and also the wrist, but flexion of the forearm or elevation of the arm is impossible. The child was seen by several physicians after birth, one of whom told the mother to do nothing; and the other, that the injury was to the shoulder-joint and that the condition would gradually improve. After six months the mother took the child to one of the neighboring cities where, among other things done, an *x*-ray was taken, but nothing was found. The consultant advised her to wait and return again in six months. The mother brought the child to me six months ago, that is, when both the child and the injury were eighteen months old.

Examination of the child at that time showed a typical Duchenne-Erb palsy, the arm being limp at the side, with inability to raise it in either the horizontal or frontal plane. The whole arm and forearm were turned inward, and the palm faced backward and outward. This position is characteristic of the Duchenne-Erb palsy. Slight subluxation of the shoulder-joint was present. *x*-Ray of the shoulder showed nothing abnormal, except that the coracoid process seemed larger and curled downward. Stereoscopic examination showed subluxation with the head drawn backward.

The mother at the time was desperate and insisted that something definite be done. In view of the fact that the paralyzed muscles had always been overstretched and had never been relaxed by any mechanical treatment, the arm was put up in a splint similar to the one which you have seen in the previous case (Fig. 225).

It is well known that paralyzed muscles may not regain their contractility when they have been continuously overstretched, even after nerve regeneration, but may again recover their power after a prolonged period of rest and relaxation. In this case the aim has been to maintain this position—which you see here—constantly for six months, except when massage has been given, which has been done twice daily. The arm has been put through a series of passive motions to prevent contracture and to exercise the muscles. This treatment has served to improve the nutrition of the part; the arm looks larger and is generally in better condition. The mother thinks there has been some improvement. However, this is slight.

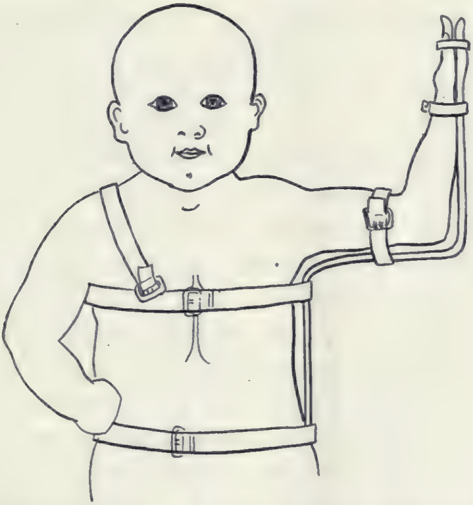

Fig. 225.—Another splint for brachial plexus injuries of the Duchenne-Erb type. Note that the splint is carried down to the pelvis so as to have its main point of pressure there. This splint may be made of aluminum. It is exceedingly light and simple.

In this connection I should like to say that no brachial plexus injury should be allowed to go without mechanical treatment designed, as far as possible, so as to prevent contracture and overstretching of the paralyzed muscles. When such treatment has not been given, no operative intervention should be undertaken until an opportunity has been afforded the overstretched muscles to regain their contractility by a prolonged and continuous period of relaxation.

I have at the present time 2 cases—one four and the other five years old—which had been untreated until they came under my care less than a year ago and which now have regained, as the result of mechanical treatment alone, 80 to 90 per cent. of function which was lost when first seen. This is all the more noteworthy, since in the one instance nothing had been done for three years and in the other for four, and goes to show that regeneration may take place, but re-establishment of contractility may not occur unless relaxation has been afforded the overstretched muscles. In both of these cases there was typical Duchenne-Erb palsy involving the fifth and sixth cords. In both the splint applied was similar to the one you have seen. Massage and passive exercises were done twice daily. Improvement began in one case in four months, and in the other in five. The patients have now worn their appliances nearly a year and have regained the function of nearly all of the paralyzed muscles with the exception of the external rotators and the radial flexors of the wrist. If improvement does not occur in the external rotators, an operation will be done to overcome this paralysis by implanting the suprascapular nerve or by reunion of the ends of the suprascapular nerve by means of a nerve-graft.

Both of these cases illustrate the value first of obtaining relaxation of the paralyzed muscles before undertaking any operative procedure, no matter what the interval may have been between the injury and the first observation.

In this case before you we have given the muscles six months of rest without any marked improvement. Further mechanical treatment I do not believe would be productive of any more improvement, and operative interference now offers the best chance. The present examination of this child shows the following:

The arm hangs limp at the side. There is marked atrophy of the entire extremity. The coracoid process is prominent and the head of the humerus is slightly subluxated dorsally. The fingers are seen moving in flexion and extension. The wrist is slightly adducted and the forearm is rotated inward, as is also the humerus. The palm of the hand is turned backward. The child is unable to raise the arm or to flex the forearm. If the forearm is flexed, it is unable to extend it. There is marked atrophy of the deltoid, biceps, and supinator longus; and there is some atrophy of the radial flexors, though it is not possible to determine precisely which muscles are involved. In an infant it is almost impossible to examine the individual muscular action; the information on the motor side must be gained by prolonged and repeated observation of the movements performed. The sensory examination is also of little value. For accurate sensory examination co-operation of the patient is essential. Obviously, this is impossible in an infant.

The electric examination shows no faradic response in the deltoid, biceps, or supinator longus. The examiner reports that further electric examination was impossible, since he was unable to determine with accuracy the response in the smaller muscles.

Analysis of this case shows then the following: Paralysis of the deltoid, supra- and infraspinatus biceps, and supinator longus, with some weakness probably of the radial flexors of the wrist and fingers. Such a lesion can only be accounted for by injury of the fifth and sixth cervical roots above the clavicle.

The seventh is not involved, since there seems to be little weakness of extension. The eighth cervical and first thoracic are not implicated, since the movements of the fingers and the shape of the hand show no paralysis or atrophy. Further evidence that the first thoracic and eighth cervical are not involved is seen in the fact that the cervical sympathetic is unimpaired, since the pupils are equal and there is no sinking in of the eyeball on the affected side. The fibers of the cervical sympathetic enter the cord through the first thoracic, sometimes the eighth cervical or second thoracic roots, so that when these roots are torn interruption of the cervical sympathetic fibers occurs. When this takes place there is a sinking in of the eyeball—enophthalmos—due to paralysis of Müller's muscle, with secondary narrowing of the palpebral fissure; contraction of the pupil—myosis—due to paralysis of the dilator fibers supplied by the cervical sympathetic, and to the unopposed action of the third nerve. This group of signs—enophthalmos, narrowing of the palpebral fissure, and myosis—is known as the Klumpke-Déjerine syndrome, and should always be looked for in any brachial plexus injury. Thus, as you see, I am stroking the skin of the neck; and those of you who are close may see that dilatation of the pupil takes place, showing that the sympathetic fibers are intact. This reflex is known as the ciliospinal reflex. Its presence places the lesion above the eighth cervical. Consequently, such a lesion as we have here can be accounted for only by injury of the fifth and sixth cervical roots above the clavicle.

The relation of the cervical roots to birth palsy was first pointed out by Duchenne, of Boulogne, in 1872; and two years later by Erb, in Germany, who cited similar cases in an adult as well as one in an infant. To Duchenne belongs the credit of having first localized the injury in the fifth and sixth cords, and that this deformity was due to a nerve lesion. Erb afterward located the lesion at the junction of the fifth and sixth cervical roots and at the point at which the suprascapular nerve is given off. This location (2 cm. above the clavicle) has since been called Erb's point (Fig. 226).

Neither Duchenne nor Erb attempted to explain the mechanism of the injury. Erb's explanation as due to traction of the fingers in the axilla during childbirth seems strangely at variance with his anatomic explanation. In this country the exact mechanism was not clearly shown until Taylor, Clark, and Prout (1905), in experimental and clinical work, showed that birth palsies of the Duchenne type were the result of any violence which forced apart the head and shoulder of the same side, thus stretching the cervical roots of the brachial plexus and in severe cases causing rupture of them. Taylor pointed out that rupture occurred first in the nerve root on which the greatest stretch was placed. These are, in the order named, fifth cervical, sixth cervical, seventh cervical, eighth cervical. The fifth, being the longest, is the most oblique and, therefore, is the first to give way, thus accounting for the greater frequency of fifth and sixth cervical root types; though, as Taylor has pointed out, any or all of the roots may be torn. When the eighth and first dorsal roots are involved the paralysis is referred to as the Aran-Duchenne type. Cases are seen at operation in which the cervical roots are found sometimes completely torn apart.

It is difficult to see how anyone could conceive of this injury as secondary to capsular lesions about the shoulder-joint. The old view, before the work of Duchenne was known, was that these injuries were bony lesions of the humerus. Küstner thought birth palsies to be due to separation of the epiphysis of the humerus; Whitman, the result of partial dislocation; and, more recently, T. Turner Thomas believes birth palsies to be due primarily to capsular lesions of the shoulder-joint, only secondarily involving the nerve in the vicinity by infiltration of blood and synovial fluid, with subsequent scar formation about the nerve.

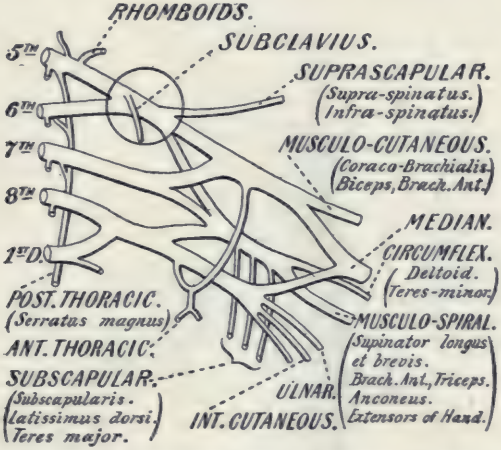

Fig. 226.—Schematic drawing of brachial plexus. Circle marks area usually involved in the Duchenne-Erb type of obstetric paralysis—Erb's point. (Binnie, "Operative Surgery.")

No doubt at birth occasionally dislocation of the shoulder or separation of the upper epiphysis of the humerus, or other injuries to the shoulder-joint, may appear, as Küstner, Whitman, and T. Turner Thomas hold. However, the Aran-Duchenne-Duchenne-Erb, or the Duchenne-Erb paralysis alone, such as we have here today, obviously involving muscles supplied through the fifth and sixth nerve roots, can only occur as the result of an injury primarily to these roots above the clavicle.

Such an injury cannot result from any secondary injury to the shoulder-joint. *It would seem hard to account for a complete anatomic interruption of one or all of the cervical roots as the result of the escape of synovial fluid from the shoulder-joint, and scar formation!* To tear these roots considerable force is needed. Complete interruption of the cervical roots, one or more, is frequently found at operation upon these birth palsies. In no instance in which we have made the diagnosis of birth palsies and have operated have I failed to find anatomic evidence of injury to the nerve roots above the clavicle, as indicated by the

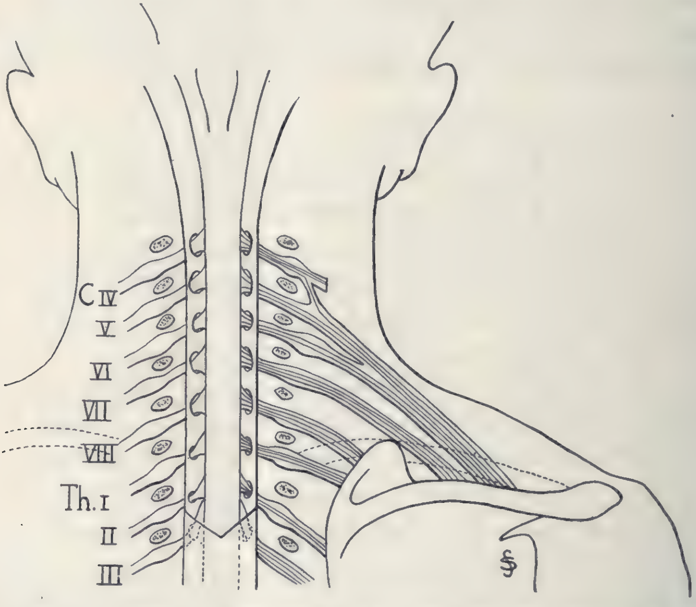

Fig. 227.—Schematic drawing of the brachial plexus as seen from behind, showing origin of the roots of the brachial plexus from the spinal cord. The vertebral arches have been cut away and the dura mater opened. The lines within the nerve trunks represent the funiculi.

distribution of the motor paralyses which led to the diagnosis. Birth palsies of the type I have described here are due *primarily* to rupture, partial or complete, of any or all of the cervical roots which enter into the formation of the brachial plexus (Figs. 227, 228). Injury to the shoulder-joint may exist as a concomitant lesion, but injuries to the cervical roots in these cases are not secondary to injury of the shoulder-joint.

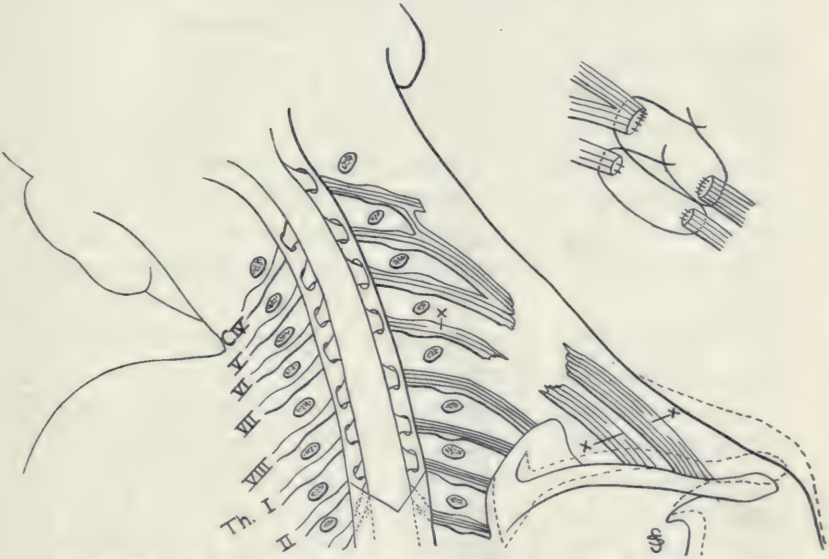

Fig. 228.—Same as Fig. 227. Schematic drawing to illustrate mechanism of rupture of the brachial plexus as seen in obstetric paralysis. The head is bent laterally beyond 30 degrees and the right shoulder lowered, thus increasing the acromiomastoid distance. The fifth and sixth roots are torn across at their junction; the seventh root is also torn. Note the irregular line of rupture of these roots, and also that the funiculi are torn at *x* within the nerve trunk, both distally and centrally. Insert shows sutures in place and nerve ends prepared for suture.

In this connection, it is interesting to note that similar palsies occur in adults as the result of trauma which forces the head and the shoulder violently apart, that is, increasing the acromiomastoid distance. I have at present 2 such cases: one, a young man of about twenty, who fell off a scaffolding only 10 feet high and landed on the right side of the head and the right shoulder, thus inclining the head and neck forcibly to the left and the shoulder in the opposite direction. A paralysis resulted similar to a typical birth palsy, the same muscles being involved and the same characteristic deformity appearing, with the arm rotated inward and the hand facing backward. In the second case an Italian aged thirty was struck on the shoulder while at work as a construction foreman by a heavy stone which fell from one of the chains as it was being lifted off the wagon. The stone struck a glancing blow on the shoulder and immediate paralysis resulted, involving not only the fifth and sixth but also the seventh cervical roots. In neither of these cases was there any clinical evidence of fracture or dislocation at the shoulder-joint. In both of them forcible increase of the acromiomastoid distance resulted in paralysis similar to those seen as the result of obstetric paralysis. Thus a similar mechanism produced similar pathologic changes in both the infant and the adult.

You may ask me what should be the treatment of these cases from the moment they are first recognized.

As soon after birth as the paralysis is appreciated the arm should be placed in a sling or the sleeve pinned up to a cap, so as to prevent the arm from dragging down the shoulder and separating the nerve ends. A small pad should be worn in the axilla to raise the shoulder and thus tend to approximate the torn nerves. This position should be held until the child is two or three weeks old, at which time a splint similar to the one you have seen may be made, except that in the early stages of the injury the arm is carried more vertically, thus raising the shoulder and lessening the acromiomastoid distance. Such a splint can be made out of plaster or light metal, removable, so as to permit bathing and massage of the extremity. Both massage and passive movements should be done daily, and galvanism may be applied. If the case is thus treated, one may wait a year before interfering surgically. By this time the child is stronger and larger, and there is more room to work and less shock from the operation, though the scar between the nerve ends may become more dense.

You may ask how long one may wait expecting regeneration. I would answer that if the case has been properly treated mechanically, delay of a year is not harmful. Unless sufficient time is awaited for regeneration to take place it seems unreasonable to delay three or four months and then to interfere. Such a time is rarely sufficient to admit of downgrowth of neuraxes. On the other hand, due to the nature of the trauma to the nerve ends in birth palsy, I do not believe each case should be operated as soon as the diagnosis is made, since the lesser injuries at first cannot be distinguished from the more severe, and the *lesser* may get well without operation. If then, delay is to be agreed to, it seems to me perhaps permissible to wait sufficiently long to allow of regeneration and not arbitrarily decide to wait three or four months. However, no set rule can be established, and each case must be judged by itself. To delay longer than twelve months, providing the case has been properly treated mechanically, seems to me unwarranted. In such cases, in which regeneration has not taken place, surgical interference is indicated. On the other hand, cases have been reported, which, however, I have not been able to verify, of nerve suture being done successfully ten years after injury, so that according to this view one need not despair of nerve regeneration even in the presence of a late operation. However, generally in prolonged paralysis the muscles have undergone retrogressive changes and there is little left for the nerve to innervate, even if down growth does occur.

When the nerves have been pulled apart, as they are in such a case as this—that is, by forcible separation of the head and shoulder—the injury to the nerve trunk is not sharply defined, since the funiculi may be pulled apart not only where the gross interruption of the nerve trunk occurs but also within the nerve trunk at various levels both within the central and the distal segments (Fig. 229); the funiculi may even be evulsed from the cord itself. For these reasons nerve suture offers the least favorable opportunity for regeneration when contrasted with incised wounds. In the latter, the funiculi in the central stump all have their central connections and those in the distal are intact: However, when the nerve roots have been torn apart and have not reunited when placed—as the result of proper splinting—in a mechanically favorable position, operation offers the best possible chance of any success and consequently is worth attempting; yet the limitations due to the nature of the injury should be definitely appreciated.

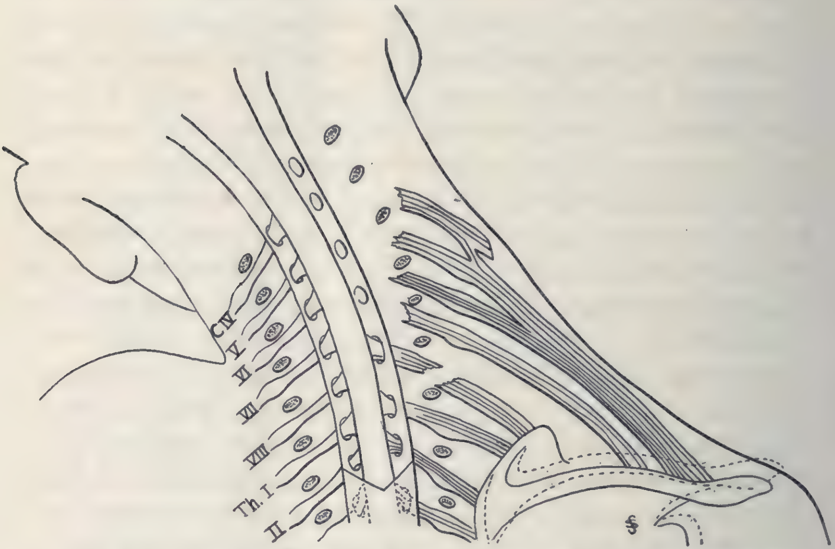

Fig. 229.—Same as Fig. 227. Schematic drawing, showing more severe type of injury to brachial plexus. The roots of the brachial plexus are shown avulsed from the spinal cord. The fourth, fifth, sixth, and seventh cervical roots are completely avulsed; the eighth cervical is torn across within the intervertebral foramen; and the first thoracic shows rupture of the funiculi from the spinal cord, while the outer continuity of the nerve trunk is still maintained.

Before proceeding with the operation it might be well to remind you briefly of the anatomy of a peripheral nerve and a few points concerning nerve regeneration.

The unit of a peripheral nerve is the nerve-fiber or neuraxis. These are the axons of anterior horn cells (motor fibers) or the peripheral processes of the cells of dorsal ganglia (sensory fibers), as well as fibers from the sympathetic ganglia which enter the nerve through gray rami communicans.

The nerve-fibers within a nerve trunk are divided into those having a medullary sheath and those without such a sheath. The former are called medullated fibers; and those without the medullary sheath, non-medullated. Surrounding the non-medullated nerve-fibers and the medullary sheath of the medullated fibers is a thin outer layer having an oval nucleus on its inner surface. This layer is called the *neurolemma*.

Both medullated and non-medullated fibers are grouped together within the peripheral nerve in bundles, termed *funiculi*, having a connective-tissue sheath which is called *perineurium*. The individual fibers of such a funiculus are separated from each other by a connective tissue called *endoneurium*, and the funiculi are bound together, forming the peripheral nerve, by an outer dense connective-tissue sheath, called the *epineurium*. Thus the *epineurium* is the outer sheath of the nerve trunk; the *perineurium*, the sheath which surrounds each funiculus; the *endoneurium*, the sheath separating each nerve-fiber; while the *neurolemma* is the thin fine nucleated sheath surrounding both the non-medullated fibers and the medullary sheath of medullated fibers.

I have gone only briefly into detail so as to give the correct terminology in speaking of nerve suture and nerve repair. Frequently one sees the term "neurolemma suture" used, whereas epineural suture is meant. Neurolemma suture obviously is not possible, since it would mean a suture of the sheath of each individual nerve-fiber.

I might briefly remind you that formerly two views of nerve regeneration were held: one, that the nerve-fibers regenerated in the peripheral nerve segment of the severed nerve, without necessarily down growth from the central stump taking place; the other, that regeneration occurred *only* as an outgrowth from the neuraxes of the central stump, the distal stump serving principally as a series of conducting tubules for the outgrowth of the neuraxes from the central stump. This latter view has been proved by numerous investigators, notably Huber, Ransom, and others, and is the only one now accepted. Thus, if a nerve is severed, the neuraxes in the distal stump undergo fragmentation and absorption, while those in the central stump divide and begin to grow out toward the peripheral stump. A single neuraxis may form ten to fifteen branches, each of which may grow out and attempt to find the peripheral stump, the latter serving as conducting tubules for the down-growing neuraxes.

It has been asserted that downgrowth of neuraxes takes place at the rate of 1 to 2 mm. per day. Thus, the more central the injury, the greater the distance the neuraxes must grow. However, the more distal the injury, the less the power of regeneration there seems to be, though this has not been definitely proved; so that an injury to the distal part of a nerve may require as long or longer for regeneration than if the nerve were injured more centrally.

Operation.—We will now proceed with the operation. The infant is wrapped in warm blankets and surrounded by heaters so as to prevent shock. The operation must be done in as short a time and with as little loss of blood as possible. If all bleeders are promptly grasped and bleeding reduced to a minimum, the probability of operative shock will be lessened.

The exposure is the same as in the previous case. I am now down upon the deep cervical fascia. It is thickened over the fifth and sixth cervical roots. Perhaps the cervical fascia was torn at the same time the nerve roots were injured. I am freeing the nerve roots from the surrounding scar, due greatly, perhaps, to the escape of blood *from the nerve ends* when they were torn, *not* blood or synovial fluid from the shoulder-joint. Here is the fifth root completely torn across. Note its enlarged end, due to the persistent effort of the neuraxes at regeneration. Here is the sixth root, also torn across—no, here is a small band connecting it with the distal part. I am following this to the distal segment. This band is only scar tissue. I am putting gentle traction on the distal segment so as to mobilize the distal end. When traction is being applied it should only be applied to the distal segment, and only slight traction is permissible. This should always be done at the distal end only, thus avoiding injury to the central stump, since the latter is the source of regenerating neuraxes. The distal stump is now freed, and I am excising into it so as to obtain a cross-section in which the funiculi may be seen, and in which scar tissue is absent.

I am now freeing the central and am excising into the central stump of both the fifth and sixth roots. We have now a good cross-section in both, though the fifth is torn near the intervertebral foramen. The funiculi are plainly visible in both. They appear as small tubules and stand out distinctly. Good cross-areas must be obtained both above and below in order to facilitate downgrowth of the neuraxes.

The shoulder is being raised so as to allow approximation of the nerve ends. I am placing one through-and-through catgut suture, and the others are epineural sutures of fine silk. End-to-end apposition is now obtained, but is not so perfect as we should like. In an infant we cannot spend so much time as in an adult, nor when the shoulder is raised can we work readily in the wound, since most of the space is obliterated by the position of the arm.

The wound is now closed in the usual manner, and dressing and splint applied. The splint is always made before the operation and properly fitted, so that it can be applied at once. The splint is designed to hold the arm almost vertically and thus insure elevation of the shoulder, thereby diminishing the distance between the acromion and mastoid, and thus helping to approximate the nerve ends. The arm is kept in this position for three weeks, and is then gradually lowered to a right angle.

We shall not expect much improvement in less than a year, since it should be remembered that the neuraxes must grow out from the central stump and make the motor and sensory connections distally. It is always well to explain this to the parents beforehand, and to insist upon continuing mechanical treatment as well as massage and electricity.

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THE SURGICAL CLINICS
OF
NORTH AMERICA

Volume 1 Number 3

CLINIC OF DR. EDWARD H. NICHOLS

Boston City Hospital

HEAD INJURIES

The cases which are to be shown or reported this morning illustrate the various common types of head injury. It must be remembered that the injury of the brain in head cases may be slight or severe, may produce symptoms of brain injury varying from a very temporary loss of consciousness to death from profound destruction, although practically all cases of brain injury are characterized by some interference with the mentality, either temporary or long continued, immediate or delayed, for a variable time after the injury. In any event, it is to be remembered that the injury of most consequence is the injury to the *brain*, and not the injury to the brain box—in fact, very severe injury to the brain box may be associated with almost no signs of brain injury. For convenience of description the different injuries are classified as follows:

1. Concussion of the brain.
2. Fracture of the bony vault.
3. Fracture of the base of the skull.
4. Laceration of the brain.
5. Intracranial hemorrhage.

CONCUSSION OF THE BRAIN

Characterized by signs of temporary interference with mentality, with temporary injury to the brain, but with no evidence of injury to the brain box.

During the past year there have been on my service at the hospital the following cases classified as concussion:

Number.	Well.	Operated.	Died.	Operated—deaths.
22	21	1	1	1

The lesions in cases of concussion is believed to be an increase of fluid ("edema") of the brain due to the shaking up of the brain produced by violence. The simplest type of this lesion is illustrated by Case I, who was brought to the hospital forty-eight hours ago, and who will be discharged today.

Case I.—A. S., forty-five, laborer. At 9 A. M., forty-eight hours ago, he was heaving on a tackle in the hold of a ship, when the fall parted and the broken end struck him a violent blow on the side of the head, knocking him unconscious. He was at once brought to the hospital, and on admission, twenty minutes later, was still unconscious, but recovered consciousness in about ten minutes; for a short time he was dazed, but in twenty minutes more he was perfectly conscious and rational. There was at no time paralysis, nor any bleeding from mouth, nose, or ears, and no evident external contusion or wound. The pupils were equal and reacted to light, but the reaction was rapid and considerable in amount; there was neither strabismus nor nystagmus. Abdominal and cremasteric reflexes and knee-jerks were present and equal, there was no ankle-clonus, Babinski, or Oppenheim. The patient was kept quiet in bed, given 1 ounce of salts, and for the first twenty-four hours given a light diet. The order left in the order book reads, "Rest in bed, quiet, milk diet, salts 1 ounce. Watch carefully for stupor, unconsciousness, twitchings, convulsions, marked change or inequality of pupils, and for any paralysis and pulse below 60. Immediately report if any of these symptoms appear. Keep three-hour blood-pressure chart and hourly pulse." This was maintained for twenty-four hours. At the end of that time the only complaint was a slight headache, and the patient was allowed out of bed. There has been no rise of temperature. The x-ray showed no fracture. The blood-pressure at no time has been above 120. This morning the patient shows nothing abnormal except a slight tenderness of the right side of the head, and will be discharged today. He will, however, be requested to return to the nerve O. P. D. in a few days for observation, and will be advised to avoid the use of alcohol.

Many concussion cases are as simple as this one seems. But it is not to be assumed that all cases are as trivial. Occasionally mental symptoms persist for days, and occasionally for months. Some of these cases are for some time easily confused by attempted mental exertion or study, sometimes for months, and often should be forbidden, and never should be urged to hasten to begin mental exertion. That not all cases of concussion are trivial is shown by the following case:

Case II.—J. McL., seven, male, schoolboy. Was struck by a motor, and at once brought to the hospital by the motor. On admission the child was semiconscious and restless. The pupils were dilated, equal, but did not react to light, blood was flowing from mouth and nose, none from ears. There were no abdominal or cremasteric reflexes. Later the right pupil became greater than the left, there appeared a double Babinski, and the right arm and leg became spastic. An immediate left osteoplastic temporoparietal decompression was done under ether, 7 cm. in diameter. At operation no hemorrhage was found, but the brain was injected, boggy, and bulging. The child died in seven hours. A medicolegal autopsy showed no fracture of the skull, no laceration of the brain, but swelling (edema) of the brain was general.

The symptoms of concussion vary a good deal, but certain symptoms are constant. After an injury of greater or less severity there is evidence of mental disturbance varying from a very temporary confusion to profound unconsciousness, which may last twenty-four or forty-eight hours or more. In relatively few cases there is an immediate period of great mental excitement, during which in exceptional cases the patient may be violent or even dangerous. In very slight cases the chief symptom may be a disorientation—the patient cannot tell his name, the day of the week, the date, or the time of day. At this stage the pupils are equal, usually react, and the reaction is usually violent. Most of the deep reflexes are present and equal; there is no clonus, Babinski, or Oppenheim; there is no paralysis; most cases vomit. The disturbed mental condition lasts from a few minutes to forty-eight hours, rarely longer. In some instances restlessness is extreme. As the symptoms diminish headache is frequently complained of. There is *usually little if any rise of temperature.* This is important, as a marked rise of temperature usually indicates laceration of the brain. Nearly all of these cases recover without operation.

FRACTURE OF THE VAULT OF THE SKULL

Under these cases are included all cases in which fracture may be demonstrated, either by palpation, inspection, or x-ray. In a large proportion of these cases there will be some symptoms of temporary brain edema (concussion), but no evidence which permits localization of the brain injury. During a period of twelve months the following cases of this sort were admitted to the hospital on my service:

	Number.	Well.	Operated.	Died.	Operated—deaths.
Simple fracture......	23	21	2	2	2
Compound fracture..	19	19	5	0	0

It should be emphasized again that the important feature of these cases is the character and extent of the brain injury. The fracture of the skull is usually of slight consequence. This is shown by

Case III.—R. L., twelve, male, a schoolboy. The child tripped and fell on the subway stairs, striking his head. Was brought at once to the hospital. On arrival he was semiconscious and vomited twice after admission. There was no paralysis. There was a marked hematoma over the right occiput. Pupils were equal, moderate size, and reacted vigorously; there was slight lateral nystagmus, which disappeared that same day. Systolic blood-pressure was 90. The child was restless during the day and early part of the night. On the second day the boy complained of photophobia, but examination of the fundus showed no swelling of the optic disks; the reaction of the pupils was still marked. The pulse, at first 90, dropped to 60, the temperature did *not* rise. x-Ray on that day showed a "linear fracture of the right occipital bone without depression or separation." There have been no notable symptoms since, and today, the eighth day since the injury, the patient is up for the first time. (The patient was discharged on the twelfth day with no abnormal symptoms.)

Except for the *x*-ray the case would have been considered a case of concussion. The relative unimportance of the fracture is evident.

Even in some cases of compound fracture the brain injury may be unimportant, as is shown by Case IV.

Case IV.—P. C., thirty-seven, male, a machinist, was struck on the top of the head by a trolley wheel, which fell about 9 feet. The patient did not lose consciousness, although he was dazed, but walked to the hospital. He showed a scalp wound 1½ inches long over the vertex down to the bone; at the bottom of the wound was seen and felt a linear fracture, without depression or separation. There were no abnormal reflexes except that the pupillary reflexes were very active. There was no paralysis. It was thought that the fracture involved only the outer table. The wound was cleaned and closed tight. This morning (the second day) the patient is perfectly clear, the *x*-ray shows no evidence of fracture (although it was seen and felt yesterday), and he demands to leave the hospital. Temperature is 98.8° F.

The slight importance of the *fracture* will be seen by examining the results of operation on these cases. Of the simple fractures, 2 were operated, and 2 died. Both of these cases were operated for the relief of pressure because of evidence of severe edema. Of the 19 compound fractures of the vault, 5 were operated, and all lived. Of these 5 operated cases, in 4 instances the bone was elevated, but the *dura was not opened*. This was because the evidence of brain injury was very slight. It was desirable to elevate the depressed bones, but it was not thought necessary to open the dura with the added risk of infection in the face of the negligible brain injury. The high percentage of recovery is believed to be due to the fact that the cases of compound fracture may automatically decompress the brain at the time of injury and prevent the occurrence of severe edema.

FRACTURE OF THE BASE OF THE SKULL

In these cases the prognosis is much worse than in cases of fracture of the vault. The reason for this is obvious, for in fracture of the base in many instances the fracture involves a sinus at the base of the brain and serious hemorrhage ensues. Moreover, the histories show in most although not in all instances that the violence producing the injury is much more severe than in the cases of the fracture of the vault. As a result the injury to the brain secondarily produced may be very destructive. In the cases classed as fractures of the base, in all cases there have been signs of concussion (edema) and marked cerebral pressure (increased blood-pressure and profound unconsciousness), with a discharge of blood or serous fluid, or both, from the ears. The cases of this type seen during the past year were—

	Number.	Well.	Operated.	Died.	Operated—deaths.
Simple	9	8	1	1	1
Compound	5	4	1	1	0

The type of injury seen in these cases is illustrated by

Case V.—J. J. M., twenty-three, male, single, chauffeur. The man had been drinking, fell in the street, striking his head on the curb, and was at once brought to the hospital in the police ambulance. He was evidently drunk, conscious, but irrational. His pupils were equal and reacted. Blood was coming from nose and left ear. There was no paralysis. All reflexes were equal, but both knee-jerks were sluggish. Blood-pressure was 130. Ear consultation showed "rupture of left ear drum, with probable fracture of base of skull, with bleeding from middle ear." The next morning the only sign of brain injury was unusually active pupillary reflexes. Nerve consultation shows "patient quite clear, no focal signs." On third day (today) bleeding from ear has stopped, patient is perfectly clear, and demands his discharge. At the time of admission the bleeding ear was irrigated, a cotton drain was inserted, and the ear was covered with a sterile dressing. In this case the brain injury was probably concussion (edema) only. The hemorrhage may have been due to a slight rupture of a lateral sinus. Since lumbar puncture showed no blood in the spinal fluid there could have been no laceration of the brain nor probably any intracranial hemorrhage. In other words, the brain injury was trivial and the fracture not important.

In many instances of fracture of the base, however, the injury to the brain is severe and destructive, as shown in Case VI.

Case VI.—J. R., ten, male. On September 25, 1920 was struck by an automobile, and within an hour was admitted. On admission the child was unconscious, but restless. Blood was flowing from nose and right ear. Temperature 97.4° F., pulse 150, respiration 40. Child vomited frequently, the vomitus was projectile in character; the blood-pressure was 75/40. Pupils were equal and reacted, no nystagmus. Abdominal reflexes and knee-jerks were absent; there was a double Babinski. Within a few minutes after admission the child became pulseless; after treatment for shock the pulse reappeared, and was about 150, but the general condition was such that no operation was considered feasible; the child died six hours after the injury. In this instance the brain injury was serious, and must have been either severe edema or laceration of the brain; there was no autopsy. The differential diagnosis was not important, as the child's condition was such as to have made no operation possible.

In some cases the fracture of the base may produce severe intracranial hemorrhage from a ruptured cerebral sinus, as shown by

Case VII.—R. F., twenty-eight, male, single. On September 27, 1920 the man was drunk and fell in the street; was at once brought to the hospital in the police ambulance. He was drunk, unconscious, restless, noisy, and unmanageable. Temperature 99.4° F., pulse 100, respiration 28. There was a contusion behind the right ear. Pupils were equal and reacted. While patient was being examined a flaccid paralysis of the left face, arm, and leg developed, the deep reflexes disappeared, and the pulse fell to 70. Lumbar puncture showed serous fluid, at first clear, but soon blood stained. An immediate right temporoparietal osteoplastic bone decompression was done, and an extradural clot was found arising from a demonstrable tear in the lateral sinus.

On opening the dura the brain was found under marked pressure with very slight pulsation, and a marked subpial hemorrhage. The sinus hemorrhage was checked by packing with gauze strips. The patient was restless and irrational that night. The unilateral paralysis continued. The next morning the patient had a muttering delirium, like the delirium of D. T. The next day the patient was clearer, and the pulse, which had been about 100, came down to 80. In an attempt to remove some of the gauze wicks the hemorrhage began again, and packing had to be continued. The pulse rose to 140 and the patient died. In this case the death was due to pressure caused by intracranial hemorrhage.

LACERATION OF THE BRAIN

In the cases shown so far it is clear that the brain injury may be the result of violence which causes edema without fracture, or edema accompanied by fracture, which may be simple or compound. Certain injuries may show, in addition to the edema, an actual laceration of the brain, slight or extensive. These cases of laceration also may be accompanied by fracture, and these fractures again may be simple or compound.

The laceration may be slight or severe; may vary from punctate hemorrhage to extensive and often fatal crushes. These lesions may be diametrically opposite the point of application of the violence, so that the injury may be produced by what is called "contrecoup." A comparatively slight case of laceration may be seen in the patient next presented, twelve days subsequent to his injury.

During the past year the following cases in which a diagnosis of laceration was made were treated:

	Number.	Well.	Operated.	Died.	Operated—deaths.
Simple..........	18	7	1	11	1
Compound......	8	1	1	7	1

Case VIII.—J. R. H., twenty-two, male, single, student. While riding a motor cycle on a muddy street the machine skidded and the patient was thrown, and is said by spectators to have struck on his head. He was at once brought to the hospital in a police ambulance. On arrival he was irrational, excited, thrashing about, and not oriented. There was an obvious right frontal contusion. The right pupil was larger than the left, but both pupils reacted to light; there was no deviation nor nystagmus. There was no motor paralysis. Abdominal and cremasteric reflexes were present and equal. There was no Babinski, Oppenheim, or clonus. The fundus of the eye showed no injury or edema. The *x*-ray showed no evidence of fracture. Lumbar puncture showed spinal fluid slightly tinged with blood. The blood-pressure was 120. The pulse varied from 45 to 60. It was a question whether operation should be done or not. On the next day the patient was quieter and clearer, although still confused; the pulse was unchanged. It then appeared that the patient, a physician's son, always did have a slow pulse. The patient steadily improved mentally, blood-pressure did not increase. On the seventh day the patient was oriented and clear mentally. Ear consultation on the second day showed "fracture of the posterior wall of the auditory canal." No paralysis developed. Today the patient is perfectly clear, reads the newspaper with understanding, has no abnormal reflexes, and is almost ready for discharge. (Was discharged on the fourteenth day, and has shown no abnormal symptoms since.) The temperature was elevated for the first six days (never over 100° F.), came to normal on the ninth day; the pulse was 80 on the tenth day.

With this patient the question of operation was considered daily for seven days. There was at no time any symptom of focal injury. It was believed that the blood in the spinal fluid indicated intracranial hemorrhage, but in the absence of evidence of severe pressure it did not seem clear that decompression was indicated, although the long-continued mental confusion seemed to indicate moderate edema, but that edema constantly improved. Had a decompression been done the recovery might have been assigned to the decompression. It is to be remembered always that the symptomatology of brain injury, however, is not exact, as will be shown by the next case.

Case IX.—M. C., female, single, housewife. Ten days before admission the patient was drunk, and fell down stairs, but was not made unconscious. She complained afterward of severe headache, but there was no paralysis. The day before admission she walked to another hospital, the head was *x*-rayed, but no fracture was found. That night she became unconscious, and the next day she was brought to the hospital in the police ambulance. On admission she was unconscious. There was a hematoma over the right parietal region. There was no paralysis. The right pupil was greater than the left and neither reacted. Knee-jerks were absent. There was a double Babinski, Oppenheim, and ankle-clonus. An immediate right-sided osteoplastic decompression was done. There was found a linear fracture through the right parietal bone, with neither separation nor depression. The brain did not pulsate. There was a thin film of blood-clot in the parietal region beneath the dura, but no sign of fresh hemorrhage. The patient left the table in fair condition, but died in ten hours. A medicolegal autopsy showed multiple fractures through the temporosphenoidal bones. Both temporal lobes showed very extensive destruction, with infiltration with blood, with marked softening of those areas. The area involved was on each side about 10 by 6 cm. and about 2 cm. deep. All sinuses, both middle meningeal arteries, and all basal vessels were intact. The temperature on admission was 102.8° F.

The notable features of this case were the extensive destruction, which, however, caused no focal symptoms, and the elevated temperature, which is constant in these cases of brain laceration.

INTRACRANIAL HEMORRHAGE

In addition to the cases of edema, with or without fracture, and of laceration, with or without fracture, there is still another type of intracranial injury which is common, fatal if unrecognized and unrelieved, and which again may be accompanied with fracture either simple or compound. In this class are included all cases of intracranial hemorrhage from arteries or from sinuses. These hemorrhages may be extradural or intracerebral.

During the past year the following cases of intracranial hemorrhage have been treated at the hospital:

	Number.	Well.	Operated.	Died.	Operated—deaths.
Simple	4	2	3	2	2
Compound	2	2	2	0	0

The last case reported today gives a classical series of symptoms, and illustrates the brilliant results often obtained by surgical treatment.

Case X.—A. K. D., twenty, male, single, college student. October 20, 1914 patient was hit in left parietal region by a batted baseball at 3.30 P. M. The blow dazed him, but he was not unconscious. At 4 P. M. the patient walked to his room, about half a mile away, alone. At 5.30 P. M. a roommate found him conscious, but able to talk with difficulty. At 6 P. M. he was sent to the infirmary by a physician; at 6.30 P. M. he became profoundly unconscious. At that time temperature was 98.6° F., pulse 48. He could hardly be roused, he did not move his right arm or leg, and there was slight twitching of the right side of his face. There was a right Babinski. The patient vomited twice, and after vomiting pulse rose to 70. Pupils were moderate in size, equal, and reacted; the fundi were normal. All right reflexes were more active than left. There was right ankle-clonus; Babinski and Oppenheim right, none on the left. An immediate left-sided osteoplastic decompression was done and showed a large extradural clot, about 8 ounces, with active hemorrhage from the middle meningeal artery, checked by gauze packing, as the vessel could not be tied. At the end of forty-eight hours improvement was great, no paralysis, no headache, no difficulty in talking, normal reflexes, and he could read. At the end of eighteen days he was up and about, no paralysis, and no aphasia. By December 2d he was back in college, doing college work. In February he passed all his examinations, and in June was graduated with his class (1916). He was later commissioned a lieutenant in the A. E. F., and at that time the examining physician observed no defect in the skull. An *x*-ray taken at Camp Devens in June, 1918 showed that the bone defect was completely closed by bony tissue. The patient, most unfortunately, was killed in France in the summer of 1918.

These cases have been classified under five headings, but it will be seen that there are but three classes of injury to the brain—edema, laceration, and hemorrhage. The injury of the cranium is of very little consequence. In many instances except for the *x*-ray it would be impossible to detect the injury of the skull; in some cases there is no evidence of any brain injury. It undoubtedly often is true that fracture of the skull exists in cases considered to be contusion only. In some cases the fracture may cause a secondary rupture either of an artery (middle meningeal) or of a brain sinus. In these instances the hemorrhage may produce secondary cerebral pressure and demand an operation, but the operation is for the relief of the hemorrhage and, naturally, is not for the fracture. Edema with its resulting increase of intracranial pressure is the most common cause of brain symptoms. Edema alone is present in nearly all cases of concussion, and as the cases and figures show, nearly all recover spontaneously. In edema alone the spinal fluid is clear, not bloody, and one most informing symptom—the temperature in these cases remains *low*. In cases of pure edema operation very rarely is called for. Rarely the edema is so extreme as to demand operation for relief of pressure. In a few cases a *persistence* of or increased pressure, with persisting mental confusion made a decompression operation desirable, but these cases are rare, and *improving* cases almost never should be operated. The presence or absence of a fracture has but little effect upon the decision as to the desirability of operation except in cases of depressed fracture.

Practically all cases of depressed fracture should be operated on. In many cases of depression the accompanying pressure (edema) demands immediate relief, whether the fracture is simple or compound. In many cases the immediate pressure is so great as to demand immediate relief, in other cases the pressure of the depressed bone may not be severe, but the depression should be elevated, because otherwise months or even years after the injury cysts or areas of sclerosis or areas of softening may occur and cause serious focal symptoms or spasms, and the results of later operations are much less satisfactory than is the case in early operation.

The results of brain laceration are serious, often fatal. The recognition of these cases is not always simple, often being confused with severe concussion (edema). The pathologic condition cannot always be determined with accuracy (cf. Case IX). The hemorrhages vary from minute petechiæ to very extensive smashing and crushing, and the location of the laceration may be

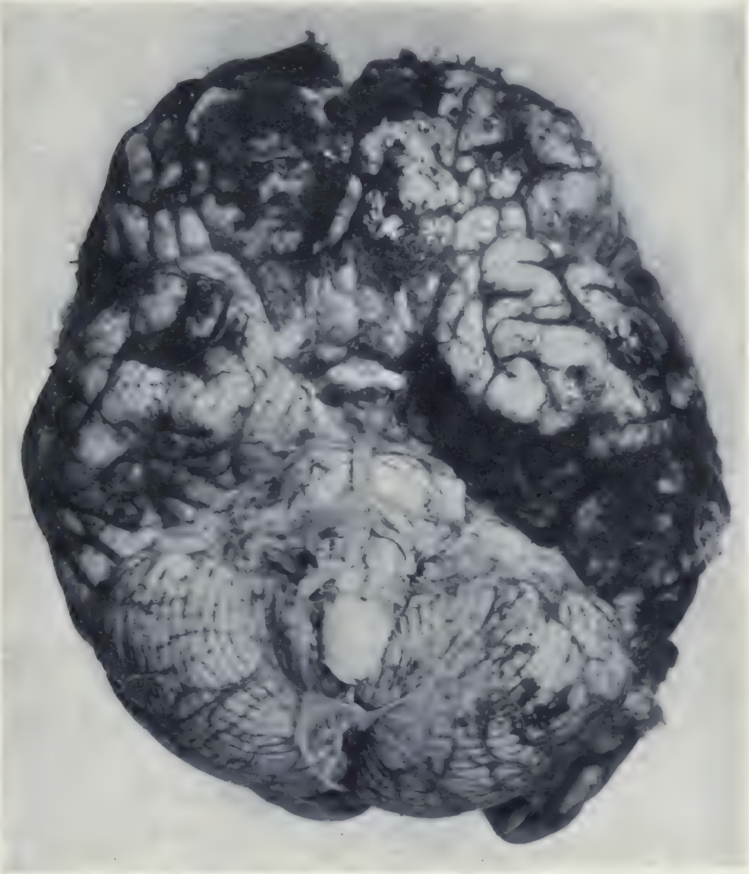

Fig. 230.—Photograph of base of brain. Severe laceration. Patient struck by a motor. Brought to the hospital semiconscious, lived four days. No obvious change of symptoms. Visible injury over vertex; the serious injury of brain is right temporal and both frontal regions (contrecoup). Edema symptoms never marked. Futility of operation obvious.

diametrically opposite the point of application of the primary force (contrecoup). The cases of laceration are nearly always accompanied with marked edema. The determination of laceration is best made by spinal tapping. In pure edema the fluid will be clear and the temperature will be low; in laceration the spinal fluid will be blood tinged, and within twenty-four hours the

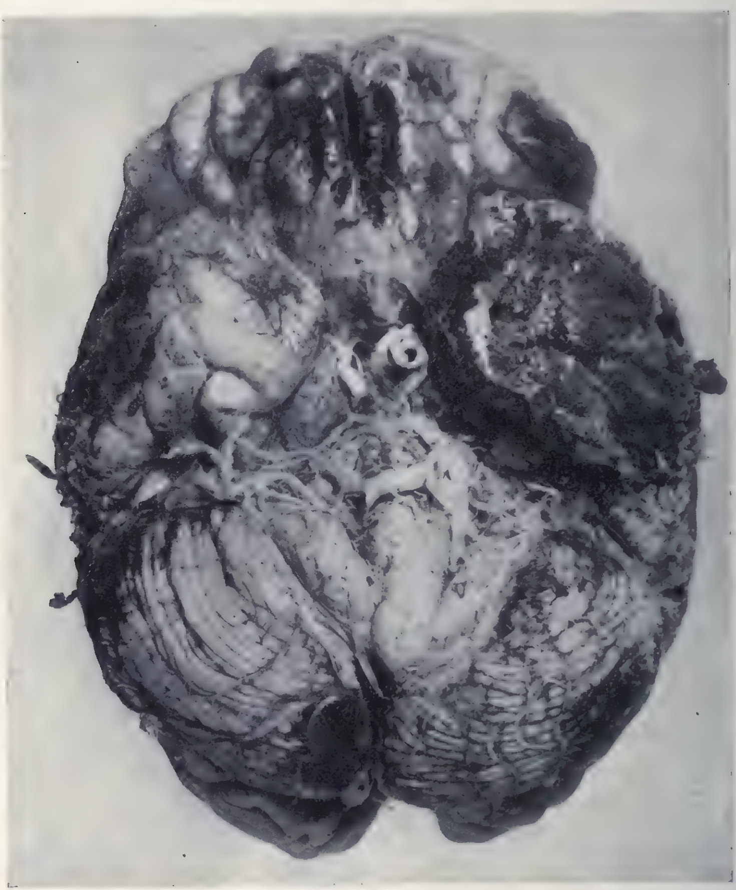

Fig. 231.—Photograph of base of brain. Patient fell down stairs. External injury over back of head, brain injury in both temporal and frontal regions (contrecoup). Edema not marked at any time. Great destruction of brain, and uselessness of decompression evident.

temperature will rise and remain high (101° F. or more). In both edema and laceration the pressure of the spinal fluid may be high. The most difficult decision as regards operation is between cases of moderate laceration with but little blood in the spinal fluid and severe edema. Many if not most cases of

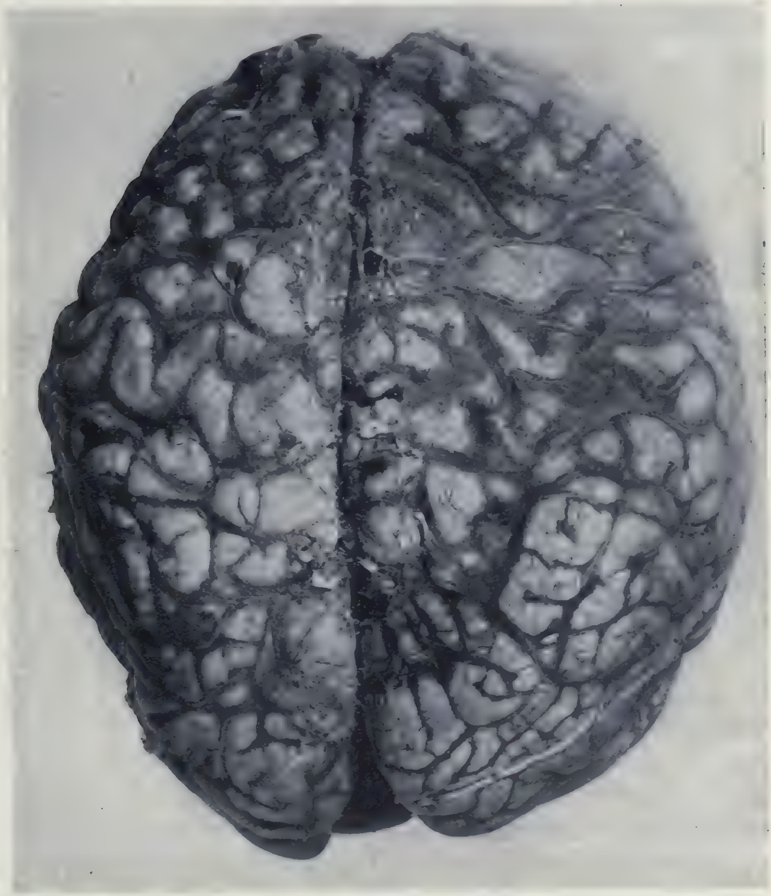

Fig. 232.—Photograph of upper surface of brain. Injury due to fall or blow. Young woman with a history of a fall in the street. Marked depression over left posterior parietal region, due to extradural hemorrhage. No blood in spinal fluid. Flattening of left parietal region evident. Death in twenty hours.

laceration die, most cases of edema recover without operation—it is not always possible to differentiate.

All cases of hemorrhage should be operated at once the diagnosis is made. It is not always easy to decide between laceration and hemorrhage, or even edema and hemorrhage. In subdural hemorrhage, as in laceration, there will be blood in the spinal fluid; edema may be present in both. But in the classical subdural hemorrhage (see Case X) there comes, first, unconsciousness or confusion, often temporary (result of edema), soon followed by consciousness (relief of edema), again followed after a variable period (thirty minutes to twenty-four hours—apparently dependent upon the site of hemorrhage) by unconsciousness, perhaps preceded by a short period of cerebral irritations (convulsions or spasms or increased reflexes). The second period of unconsciousness is due to increased intracranial pressure caused by hemorrhage. These cases all should be operated. Also in these cases there almost always are focal symptoms indicating the place of the hemorrhage.

In extradural hemorrhage it may be difficult to distinguish the lesion from a case of severe edema. In some cases of edema (cf. Case II) there may be focal symptoms. In some cases of extradural hemorrhage there will be a clear spinal fluid with focal symptoms. It may be impossible to distinguish such a case from edema. One thing is clear, however, that in all cases of evident focal symptoms operation is indicated.

One fact is evident. In all cases of injury to the head, accompanied by cerebral confusion, even if temporary, the patient should be kept under observation for at least a full twenty-four hours. If at the end of that time the patient is clear mentally and shows no paresis or focal symptoms, it may be fairly concluded that the danger period is past, as it is exceedingly unusual for hemorrhage to develop after that time. Before that time all head injuries carry the possibility of serious hemorrhage.

Just one other final warning. In practically all fractures of the base of the skull the fractures are nearly all compound, therefore all compound wounds (bleeding from the ears, etc.)

should be treated like all wounds of compound fracture, *i. e.*, they should be rendered as sterile as possible.

CONCLUSIONS

1. Very few cases of edema demand operation, and then only when there is a constant rise in blood-pressure.

2. Operation upon extensive laceration offers little hope. It should be done only when edema is so extreme as to demand relief of pressure.

3. All cases of hemorrhage should be operated at once.

4. All cases with definite focal symptoms should be operated at once; they generally represent hemorrhage.

5. Dilated and fixed pupils are almost always a positive contraindication for operation.

6. One observation of high blood-pressure is of little value. Continued high blood-pressure with a depressed pulse is a strong indication for operation.

7. High pressure of the spinal fluid, as shown by the manometer reading, is of greater value than high blood-pressure as an indication for operation.

CLINIC OF DR. WILLIAM P. GRAVES

Given Before the Boston Surgical Society at the Free Hospital for Women

MULTIPLE POSTPERITONEAL CYSTOMATA. ARTIFICIAL VAGINA. MENSTRUATIO PRÆCOX. RADIUM IN THE TREATMENT OF CERVICAL CANCER. RADIUM IN THE TREATMENT OF MENORRHAGIA OF THE YOUNG

Gentlemen: I shall first demonstrate 3 cases from the hospital wards which present points of especial gynecologic interest, and then take up the subject of the use of radium in the treatment both of uterine cancer and of non-malignant uterine bleeding.

The first of the ward cases is one of multiple postperitoneal cystomata.

MULTIPLE POSTPERITONEAL CYSTOMATA

This patient is forty-five years old, the mother of 3 children. For four years she has noticed a lump in the right lower quadrant, which has appeared noticeably larger at the time of her monthly periods. There has been no pain until about four weeks before entering the hospital, during which time there was a constant sense of discomfort, with dull pain extending to the vagina. This was accompanied by sacral backache, frequency of urination, and dyspnea on exertion. Vaginal examination revealed a large tense tumor the lower segment of which was packed in the true pelvis. The cervical os could just be palpated far up under the pubes. The diagnosis made by the consulting physician and by myself was that of a fibroid uterus, possibly in the nature of a cervical myoma. At operation, performed thirteen days ago, the uterus was found studded with small fibroids and pushed high up in the lower abdominal cavity by a cystic tumor lying behind the peritoneum and greatly displacing the rectum toward the right. There was no connection between the tumor and the adnexa of the uterus. Spread out over the tumor were large flattened veins.

The removal of these large postperitoneal growths should occasion no great difficulty if certain important surgical principles are conscientiously adhered to. In the first place, it must be remembered that they have no definite vascular pedicles and that they derive their nourishment from the capillaries of the surrounding tissues. The great sinister-looking veins that appear on the surface are not incorporated in the true wall of the cyst, but are merely peritoneal veins congested and distended by pressure. They lie, therefore, in planes external to the wall of the tumor. This characteristic gives a clue to the proper technic of removal. An incision is made through the peritoneal covering as far away as possible from the overlying veins. The peritoneal layer is delicately lifted until a plane of cleavage is attained which will admit of inserting the hand between the tumor wall and the peritoneal covering. The process of cleavage is then carried on around the tumor, keeping *below* the plane of tissue which contains the large veins. When resistance to this process is met with, the temptation to cut must be resisted, and further progress be made by seeking a deeper plain of cleavage, that is to say, one that is closer to the wall of the cyst. It is always important to avoid rupturing the cyst, for once it is collapsed the difficulties of its removal without causing hemorrhage and tearing of the surrounding tissues are greatly increased. When the wall of the cyst is thin or necrotic, the sounder portions should be enucleated first, so that if rupture is inevitable it may be postponed until the tumor shall have been for the most part delivered. In this way the operation may almost entirely be completed by the fingers and open hand.

In the case before you the technic just described was carried out properly until the last few shreds of adherent tissue were reached. A necrotic portion of the cyst had just been ruptured, and in the general mêlée that followed the adherent strip of tissue was clamped and cut in the manner employed for the removal of a pedunculated ovarian cyst. In finishing the operation it was found that in the clamp which held the last pedicle of tissue was contained a loop of the external iliac vein which had been completely severed, an accident that necessitated the tying of the vein. The vessel had been widely displaced by the growth of the tumor, but its injury might have been easily avoided by a stricter adherence to the principles of technic above described. Fortunately, the tying of the vein did no harm to the patient.

The case has a further interest in that after the pelvic operation, including a hysterectomy, had been finished, another postperitoneal cyst of considerable size was discovered lying behind the descending colon, and included between the peritoneal leaves of the mesentery. The mesenteric vessels were greatly distended and apparently closely adherent to the tumor. The problem of removing this second tumor without injuring the superjacent blood-vessels was, of course, one of much greater importance than in the first operation, on account of the necessity of preserving the integrity of the circulation of the gut. An incision was made through the outer peritoneal leaf of the mesentery, the proper plane of cleavage was found, and the tumor was excochleated entirely with the hand.

I should like to call your attention to the abdominal wound in this case. You will note that an incision had been made at right angles to the median incision and directly across the left rectus muscle. This maneuver is one of much value when, during an exploratory operation through the median line, it becomes necessary to remove a lateral-lying growth. The repair of the severed rectus muscle-fibers is easily accomplished, and in my experience there has been no tendency to later hernia.

With your permission I will say a few words regarding the histogenesis of the postperitoneal tumors. They appear in a great variety of forms, including fibroma, fibrosarcoma, lipoma, simple serous cystoma, multilocular serous cystadenoma, teratoma, dermoid cystoma, etc. One may readily imagine that such tumors as the fibromata and lipomata have their origin in the subperitoneal cellular tissue in a manner entirely analogous to that which they exhibit in any other part of the body. The unusually large size that they may attain postperitoneally is doubtless due to the slight tissue resistance that they encounter during their growth. One may also imagine that some of the simple serous cysts may arise from isolated rests of the wolffian ducts.

The histogenesis of certain of the growths is, however, not as easily explained. Especially is this true of the dermoids and teratomata. These tumors, whether they originate in the ovaries or postperitoneally, are unquestionably ovigenous. Their development in the postperitoneal cellular tissue has been usually attributed to misplaced blastomeres that, after the original segmentation, have wandered away from their normal place of assembly in the genital gland and have become isolated at some point in the postperitoneal space. The acceptance of this explanation implies a belief in the germ-plasm theory of Weissmann, which asserts that the germ-cells (ova and spermatozoa) are entirely independent in their relation to the body or somatic cells, both in origin and growth. Recent studies in the embryologic development of the germinal epithelium covering the ovary have done much to disprove this theory. Thus it has been shown that the genital gland originally develops from the germinal epithelium, which is itself a local modification of the peritoneum. The growth in size of the genital gland is due to an invasion downward of the germinal epithelium, and it has been shown that all the cellular elements of the ovary with the exception of a fine connective-tissue framework are derived from the down-growing germinal epithelium. These cellular structures include the stroma, interstitial cells, the remains of the rete ovarii, and cords of Pflüger, the granulosa layer of the graafian follicles, and finally *the ova themselves*. It may be seen, therefore, that the ovarian dermoids and teratomata, being ovigenous, are derived in the last analysis from the germinal epithelium. It has also been conclusively proved that the serous cystadenomata are derived directly from the germinal epithelial layer that invests the ovary.

Bearing these facts in mind, it has seemed to me that the following may be a rational explanation of the histogenesis of some of the postperitoneal tumors:

If the embryonic peritoneum has the power of a local differentiation into the germinal epithelium, which in turn may produce germ-cells, it is entirely conceivable that this power of differentiation may abnormally appear in parts of the peritoneum other than in that portion which is eventually destined to become a genital gland. In this way cells may be created in different areas of the subperitoneal space exactly similar to those in the ovary which have the power of becoming dermoids or teratomata.

The theory of abnormal differentiation of the peritoneum into germinal epithelium is substantiated by the pathologic finding of the tumors removed from the patient before you. The larger tumor from the pelvis proved to be a multilocular papillary adenocystoma, exactly like the ordinary ovarian type. The tumor from the upper abdomen was of the same nature, though it showed a less advanced development in that the lining cells were non-papillary, and had the characteristics of germinal epithelium. It would seem that in this case the peritoneum in two abnormal locations assumed the type of germinal epithelium and had been the source of two tumors which can in no way be distinguished microscopically from ovarian cystadenomata.

I am at present preparing a paper which will more fully expound this theory.

The second case to be shown is one which illustrates a method of constructing an artificial vagina.

METHOD OF CONSTRUCTING AN ARTIFICIAL VAGINA

This patient is twenty years old and has been married for a year. She has never menstruated. She was brought to the hospital by her husband on account of the impossibility of coitus. Examination showed a typical condition of congenital absence of vagina. The external genitals were moderately well developed and the secondary sexual characteristics were within the range of normality, though somewhat meager.

The situation was explained to the husband, an intelligent Italian laborer, who earnestly requested an operation.

There are two methods that may be chosen for constructing an artificial vagina. The first is a plastic operation, by which skin-flaps are turned into an opening made between the bladder and rectum. The second method consists in employing a loop of bowel which has been resected without disturbing its blood-supply. In this case the first method was used. I had performed this operation once before in 1908 on a similar case, and at that time devised a special technic which was later published. The steps of the operation are as follows: A transverse incision, about 2 inches in length, is made across the space usually occupied by the introitus. With blunt dissection a plane of cleavage is sought beginning just above the commissure of the levator ani muscles. It will be found that the tissues may be separated with comparative ease. Some bleeding is encountered, so that it is necessary to proceed cautiously with the separation. In this way an opening is made which corresponds in its proportions to a normal vagina. It is important not to enter the abdominal cavity. Several catgut sutures with long ends are placed in the vault of the new opening and the ends tucked into the pouch for later use, as will be described. The second part of the operation is to line the opening thus formed with skin turned in from the surrounding parts. This may best be accomplished in the following manner: The labia minora are first partially amputated, the incisions beginning near the clitoris and continued downward toward the artificial opening, but leaving sufficient pedicle to allow competent circulation. The skin layers of the partially amputated labia are then separated so that they appear as two paddle-shaped flaps. Two similar flaps are then dissected from the thighs. A third and if need be a fourth may be taken from the buttocks, as shown in the drawing. In outlining the skin-flaps it is important to mark the pedicles of the paddle-shaped areas in a *curved* direction. By observing this rule the flaps may be turned face outward without causing disagreeable folds at their attachments near the artificial opening. The skin wounds made by the removal of the flaps having been sewed, a glass form, such as is used for maintaining a dilatation of the vagina, is placed at the artificial opening, but pointing *outward*, the five or six skin-flaps are then sewed together over the glass form, the flaps being turned so that the skin surfaces face externally. Great care should be taken to secure accurate coaptation of the skin edges, and to fit the cap of skin smoothly over the glass form. When the sewing of the skin-flaps has been nearly completed the ends of the sutures that had been attached to the vault of the artificial pouch are now brought out, threaded into needles, and passed through the dome of the cap made up of skin-flaps. By carefully inverting the cap the artificial pouch becomes lined with a layer of skin which may be fastened snugly in place by tying the sutures that had been placed in the vault. The final step in the operation is to close with fine catgut sutures the remaining openings in the skin-flaps at the introitus.

The patient before you was operated on about six weeks ago. If you will examine her you will find that the skin lining the new vagina has already become modified in character, so that it is now soft and moist and devoid of hairs.

Although I have never attempted the so-called Baldwin operation of bringing down a loop of gut into the artificial opening made between bladder and rectum, I am convinced that it has no advantages over the procedure that I have just described. It certainly subjects the patient to a far greater operative risk. Moreover, the disadvantages of a vaginal lining composed of such a secreting and absorbing surface as the intestinal mucous membrane more than outbalances the slightly greater depth of the vaginal pouch that the operation may attain.

The patient upon whom I first operated was married soon afterward. That the operation was successful is attested by the fact that ten years later the husband called on me to express his gratitude and satisfaction for what had been done for his wife.

Congenital absence of the vagina is not a very rare defect. During my service at the Free Hospital we have seen, including the present one, 5 cases. The defect appears to represent an arrested development of the lower segments of the Müllerian ducts. It was formerly believed that many of these patients were without ovaries because frequently the glands could not be palpated by rectal examination. This was undoubtedly an erroneous conclusion. In 4 of our cases the external genitals and secondary sexual characteristics were normally developed, and in 1 case the patient was an unusually fine physical specimen of womanhood. One of the 5 cases was a girl under twenty years of age, who showed evidence of a deficient general development. She applied for relief from severe hot flushes. An operation for castration was advised and willingly submitted to by the patient. At operation two fully developed ovaries were found lying well above the brim of the pelvis, thus accounting for the fact that they could not be palpated by rectum. Both fallopian tubes were completely developed, but the uterus was very rudimentary, being not much larger than a pea. A fine solid strand of tissue descending for a short distance below the uterus represented the rudiments of the vagina. Removal of the ovaries produced a complete relief of symptoms.

The next patient to be shown is another gynecologic curiosity, from the fact that she gives an unusual history of menstruatio præcox.

MENSTRUATIO PRÆCOX

This patient is thirty-seven years of age, married sixteen years, and the mother of 2 children. For eight years she has noticed a gradually increasing lump in the lower abdomen. During this time she has had occasional attacks of abdominal pain, chiefly at the time of her periods. At the time of entrance into the hospital she presented a condition of rather marked anemia, the hemoglobin being 45 per cent., although there had been no excessive loss of blood. At the operation, which was performed eleven days ago, a large, very adherent fibroid uterus was removed. The convalescence has been uneventful.

The patient states that she was born menstruating, and that until she was eight years old she had a slight bloody discharge each month. The menstruation then ceased for two years, but reappeared at the age of ten, and has continued at normal intervals and in normal quantity until her last period, which occurred a little over three weeks ago. This history has been verified by the patient's mother and older sister.

It seems evident that the menstrual precocity in this case was due to some minor functional activity of the glands of internal secretion. One would expect from so extraordinary a history to find some associated disease of the pineal, or pituitary, or thymus gland, but there is no evidence either in the patient's history or in her present appearance of such abnormality. Judging from the mother's story it is probable that the development of puberty did not take place until the age of ten. The infantile menstruation, therefore, could not have been of very profound significance. Precocious menstruation of the ordinary type is usually an inherited peculiarity. In this case it is interesting to note that the mother menstruated at the age of eleven, and that the older sister reached puberty at the age of nine. Inquiry of the mother as to the patient's early mentality reveals that she was somewhat above the average in intelligence. She has during her life exhibited exceptional musical talent, and is distinguished among her friends for her entertaining wit.

There may be some etiologic relationship between this patient's menstrual history and the large fibroid that was removed at operation. It has been a matter of personal observation corroborated in the literature that patients who have had an early puberty are especially prone to fibroids later in life.

RADIUM IN THE TREATMENT OF INOPERABLE CANCER OF THE CERVIX

We will now turn our attention to some radium cases, and I shall first show a few patients who have been treated for cancer of the cervix uteri. These cases are not presented as brilliant successes of the radium treatment, but only to demonstrate the average results attained by the application of radium to advanced cervical cancer.

I should preface my remarks on these cases by saying that we are at present treating only those patients in whom the disease is definitely inoperable. It should be added also that since the advent of radium our definition of what is operable and what is inoperable in cervical cancer has undergone some modification. Formerly we regarded as operable a case of cancer wherein it appeared possible to perform a radical operation without killing the patient or without mutilating the hollow organs of the pelvis, even though it seemed probable that a permanent cure of the disease could not be effected. This policy was pursued because such operations usually palliated the patient's symptoms and often greatly prolonged her life. Since the acquisition of radium, we have come to define as operable only those cases in which a radical operation offers some chance of attaining a permanent cure. We have reached this viewpoint because we have found that in these sub-borderline cases radium sometimes, though not always, produces palliative results equal to those of radical operation, and does not subject the patient to operative risk.

We have not yet become convinced that in an operable case (or perhaps one should say a *curable* case) we are giving the patient as good a chance for ultimate cure by radium as we are by operation. This, however, it must be remembered is an individual standard, which may not be applicable in other clinics. Thus when confronted with an operable case we have to decide between a rather long operative experience and a somewhat inadequate radium equipment as our two weapons for combating the disease, and up to the present time we have regarded the former as more reliable. Our radium outfit consists only of 100 milligrams in the form of salts, divided into three portions. Although this amount has been of inestimable benefit as a palliative agent, it has not infrequently proved unreliable and treacherous. I am entirely convinced that this equipment is too meagre and the possibilities of effective application too clumsy to warrant its use in the treatment of a frankly operable case. We are therefore waiting with the keenest interest detailed time-reports from those institutions in which cancer of the cervix is being treated with large doses of radium in the form of emanations. If the results from these experimental institutions turn out to be as favorable as they at present give promise of being, it will be the duty of every hospital or at least of every medical community to establish radium plants with the best facilities for its application.

The first patient in our cancer series is fifty-one years old. For ten months previous to her entrance into the hospital she had almost constant flowing, with severe continuous pain in the back extending downward into the thighs. Examination showed inoperable cancer of the cervix. On October 21, 1920 100 milligrams of radium were applied for twenty-four hours. The patient now reports for the first time. There has been no flowing since the treatment and there has been considerable though not complete relief from pain. Vaginal examination shows no great change in the feeling or the appearance of the cancer mass. This was a hopeless case from the start, especially as her symptoms indicated metastatic involvement of the regional lymph-glands. The radium, however, has distinctly relieved the patient's sufferings.

The next patient is fifty-three years old. For several months before consultation she had had intermittent flowing, foul discharge, and pain in the back and thighs. An ether examination was made June 1, 1920 to determine the possibility of operating. It was found that the patient had an inverting cancer of the cervix, extending into the parametria. Operation was not feasible. Radium was applied to the internal and external portions of the cervix.

The patient reported on November 22d, saying that she had had complete relief of symptoms, including the bleeding, vaginal discharge, and pain in the back. At that time under ether no recurrence could be felt by vaginal or rectal examination.

She now reports again. She has had a little blood in the stools. Vaginal examination, as you will see, reveals a suspicious hardness around the cervix, while by rectal palpation a dense bridge of tissue can be felt just posterior to the cervix. I have no doubt that the progress of the disease is asserting itself.

The next patient is sixty years old. She entered the hospital on June 17, 1920. She had had symptoms of bleeding for eight months, but there had been no characteristic pain. Examination revealed an inoperable cancer of the cervix to which radium was applied. She now reports that since her treatment in June there has been no bleeding, discharge, or pain. If you will examine her you will find that the cervix cannot be felt and that the upper vagina is completely closed. No evidence of the disease can be felt by vaginal or rectal examination. The patient feels and appears in perfect health.

The case at the present moment seems to represent a cure, but numerous disappointments in the past lead me to believe that the disease is only temporarily arrested and that it will eventually make a reappearance, even though it may not be for many months.

The next patient is fifty-four years old. In November, 1918 I performed a radical operation for squamous cancer of the cervix. In September, 1919 I made a mild application of radium to the vault of the amputated vagina on account of a slight suspicion of a local recurrence. In April, 1920, seven months later, the patient developed a small vesicovaginal fistula. This fistula was closed by operation, but microscopic examination of the pieces of vaginal membrane removed from about the opening showed cancer. Three months later the fistula opened again and has remained open since, gradually becoming larger.

The patient still looks and feels well, having actually gained in weight during the past six months. Examination, however, shows increasing induration of the vault of the vagina, with the characteristic hard bridge of tissue around the anterior wall of the rectum. The fistula can be felt passing through the dense unyielding vaginal vault.

This case illustrates very well the ease with which a fistula may be produced by radium, especially after a complete hysterectomy has been performed. It is one of several similar cases that have made me wary of using radium as a prophylactic measure following radical operation.

The next case is one that does not properly belong to this series of cervical cancer, but is introduced as it exhibits certain points of especial interest. The patient is sixty-four years of age. She entered the hospital in May, 1920, with a history of foul discharge with occasional bleeding. For two years she had been wearing a pessary for general prolapse. An extremely ill-fitting hard-rubber pessary was removed from the vagina. The pessary was not only too large for the vagina, but it had been inserted upside down, so that undue pressure was exerted on the lateral walls of the vagina near the orifice. Examination showed on each side of the vagina, just within the introitus, an irregular, hard, infiltrating mass, which microscopic examination of an excised specimen proved to be an epithelioma of an early cancerous type. On account of the position of the two masses and their bilateral symmetric nature it seemed probable that they had been stimulated to growth by the pressure of the pessary. As operation would entail serious technical difficulties, it was deemed an excellent opportunity to test the power of radium on an early cancerous growth. Accordingly, the two masses were treated separately one month apart. At the time of the second application the mass that had first been treated had completely disappeared. The patient was not seen again until last November. For a month she had been suffering severe pain in the vagina, with some foul discharge and blood. Examination showed no trace of the mass first treated, but on the other side there was a large indurated ulcer, with a deep infiltration of extreme hardness, extending back toward the ischiadic region. The floor of the ulcer was covered with the dense white tenacious membrane that is often seen in tissues that have been subjected to radiation. Although the feel and appearance suggested a rapid invasion of the original disease, sections from the edge of the ulcer showed under the microscope only chronic granulation tissue. It seemed probable, therefore, that the ulceration was the result of an extensive radium burn, and that the dense induration surrounding it was merely an intensification of the usual sclerotic tissue reaction which radium always produces. Various local applications had no effect whatever on the condition. Finally, under ether, the ulcer was deeply and extensively excoriated with an actual cautery at white heat. Since then the improvement in the diseased area has been remarkable. At the present time, as you may see by examining the patient, only a small part of the induration remains, and the ulcer is nearly healed over. The final outcome of this case will be a matter of intense interest.

RADIUM IN THE TREATMENT OF NON-MALIGNANT MENORRHAGIA

We shall now consider a series of cases that have been treated with radium for uterine bleeding from non-malignant causes. I have chosen for this series a set of cases that illustrate a particular phase of the subject, namely, the menorrhagias and metrorrhagias of girls and young women, with special reference to the question of the preservation of menstruation and fertility. The value of radium in the treatment of the uterine insufficiency of middle age is so well established and so well known to you that I shall omit altogether that part of the subject from my discussion.

Before the advent of radium uterine bleeding in adolescence and young womanhood presented a baffling problem. The etiology of this condition has never been solved. In a few of our cases we could trace it with a fair degree of certainty to an habitual supersexuality that kept the genital organs in a constant state of congestion. In three or four other cases a positive Wassermann reaction was discovered. But, as a rule, no tangible etiologic factor could be discovered. One may speak of ovarian hyperfunction as a cause, but the term is based on the vaguest kind of knowledge, and even if it is correctly used it is of no assistance in the problem of treatment. The various remedies for this condition, such as animal serums, gland extracts, like pituitrin, the various styptics, iron, arsenic, etc., are all of very equivocal value. Repeated curetings are equally useless. The bleeding not infrequently continues for years, and may reduce the patient to an extreme state of anemia. It may even result fatally. One patient who had been bleeding in this way for several years was brought to the hospital, almost completely exsanguinated, and died before we were able to help her. In a number of our cases we were obliged to resort to hysterectomy and castration.

In the earlier days of radium as a therapeutic agent it was applied only for the menorrhagias of women comparatively near the menopause. Operators were fearful of using it in young women on account of the danger of bringing about an artificial menopause. It was soon discovered that when radium is given in moderate dosage excessive menstruation may be diminished and regulated with a fair degree of certainty. At the present time it is employed without hesitation for urgent cases even in pubescent girls. The question of whether radium destroys fertility even though it does not stop menstruation is only recently being answered. The cases that I have to show you will throw some light on this important subject.

The first patient is now twenty-six years of age and single. You will notice that she has excellent color and in every way gives an impression of rugged health. She came to the hospital a little more than three years ago. She stated that she had begun to menstruate at the age of thirteen. For the first three months the messes had been regular and normal in amount. They then became increasingly irregular and frequent, until she flowed almost continuously, a condition which had been maintained for nearly six years. At the time of entrance in the hospital she was using from one to three napkins daily. The patient was extremely pale and weak. Examination of the blood showed a hemoglobin of 40 per cent.

On September 25, 1917 she was cureted for diagnosis; microscopic examination of the curetings revealing a permanent gland hypertrophy; 50 milligrams of radium were applied to the uterine cavity for six hours. The patient with her mother reported to me personally during the following January. With the exception of a slight show in October, there had been no appearance of blood since the operation. The patient had regained her color and was feeling in perfect health. The mother, however, was greatly distressed at the disappearance of menstruation, and was slightly threatening in her attitude. A course of ovarian feeding was instituted in the form of whole ovary capsules, 5 grains three times daily. Menstruation soon appeared, and has continued ever since, though with considerable irregularity. In general, there has been a scanty flow for two days, at about two weeks' intervals. On five occasions during the last three years there has been a smart flowing spell lasting for two or three hours.

From a physiologic standpoint the result of the single radium treatment cannot be regarded as perfect, in that an entirely normal menstrual rhythm has not been established. Nevertheless, from the standpoint of the patient's health and well-being, it is extremely satisfactory.

The next case illustrates well the value of radium in treating the uncontrollable hemorrhages of puberty. This patient came to the hospital three years ago at the age of thirteen. Menstruation had started five months before and had continued almost without cessation. The patient was in a much depleted condition. Realizing the futility of drugs and cureting, I decided to try a small dose of radium, although we had not before treated so young a patient, nor could I at that time find anything definite in the literature bearing on the subject. Accordingly, 25 milligrams of radium were applied in the uterus for six hours. The pelvic organs were normal. A specimen of the endometrium removed for microscopic examination showed permanent gland hypertrophy, a condition that one usually finds in young menorrhagic patients.

Bleeding ceased after the operation, and two weeks later a normal, rather scanty, catamenia took place, lasting about six days. Since that time the periods have come at regular six-week intervals, lasting five to six days, and requiring an average of two napkins each day. The patient is now sixteen years old and is in excellent health. In making a decision as to the treatment of a very young patient, the question of the danger of causing a complete cessation of the menses has been a most important one. Emboldened by the success of this case, I have since treated a number of patients of the same type, and have become convinced that a dosage of 25 milligrams for four to six hours may be given with entire safety. There have been two cases of recurrence of abnormal bleeding where I have used the same amount of radium for only two hours. It is quite probable that the ovaries of the young are able to withstand a greater exposure to radiation without losing their function than are the ovaries of older women, as will be explained in the discussion of the next case. Nevertheless the matter of dosage is still very much in the experimental stage, and it is necessary to recommend the greatest caution, especially in the treatment of the young. An operator who by the reckless use of radium should bring about an artificial menopause in a patient like the one before you would lay himself open to the severest criticism.

The last case is perhaps the most important one of the series, in that it serves to answer the often repeated question regarding the influence of radiation on fertility.

I first saw this patient in the spring of 1917, when she was twenty-three years old and single. At that time I operated on her for anteflexion and dysmenorrhea. The operation consisted of an Olshausen suspension of the uterus, combined with lysis of adhesions to an old appendix scar. She appeared again two years later, seven months after her marriage. She had a miscarriage two months after marriage, and had been flowing profusely ever since. A curetment was performed, the curetings showing a chronic cystic dilatation of the endometrial glands. This operation brought her no relief, and she again entered the hospital two months later, having flowed almost continuously, and requiring seven or eight napkins daily. Radium was advised and accepted. At operation the same condition, gland hypertrophy of the endometrium, was discovered; 50 milligrams of radium were applied to the uterine canal for twelve hours, the patient having been warned beforehand that this dosage might produce an artificial menopause. The patient did not menstruate for four months, after which time the menses became regularly established. If you will examine her you will see that she is now three months' pregnant.

You may perhaps be interested in a brief description of the theory regarding the action of radium on the pelvic organs when applied for the purpose of stopping or regulating uterine hemorrhage.

It seems probable that the rays exert an influence both on the endometrium and on the graafian follicles of the ovaries. The exact effect on the endometrium has not been determined, since microscopic examination of the uteri removed after unsuccessful treatment with radium reveal no very definite changes. One would expect a sclerosis of the stroma which might bring about a temporary or permanent obliteration of the endometrial capillaries. From the cases just demonstrated in this clinic it would seem that a small dose of radium may bring about a temporary change in the endometrium without affecting seriously the function of the ovaries. Thus in the case of the thirteen-year-old girl who had a very small dose of radium the menstrual rhythm was immediately produced, although with six-week intervals. Radium given in sufficiently large doses is capable of destroying the graafian follicles, as has been shown by the examination of ovaries removed after radium treatment.

I have recently performed a hysterectomy with removal of the ovaries in a patient who seven months before had had a full dose of radium for severe hemorrhages in association with a broad pedicled, submucous fibroid. After five months of complete cessation profuse bleeding recurred. Microscopic examination of the ovaries revealed a complete absence of follicles. In this case the recurrent bleeding must have been independent of ovulation and probably came from the fibroid itself.

The extent of the destruction of the follicles depends on the size and length of time of dosage, and *also* on the age of the patient. You will remember that the primordial follicles are formed near the center of the ovary, and that as they develop they migrate toward the surface, finally culminating in a ripe corpus luteum or in an atretic follicle. A large dose of radium is sufficient to destroy all the follicles in the ovary both young and old. But it may be imagined that a moderate exposure of the radium may kill only the older and riper follicles that are near the surface, while the younger and less developed bodies escape its influence. In this way may be explained those cases like the first in our series, in which the menstrual function is suspended for several months, only to be resumed in a natural manner. In other words, menstruation ceases during the period of time required by the younger follicles to mature. The fact that the menstruation in most cases is restored without the abnormal bleeding which before characterized it may be explained by some minute but permanent change in the endometrium.

As I mentioned before, it seems evident that the menstrual function is more resistant in young women. Thus in the uterine insufficiencies near the menopause a dosage of 50 milligrams for twelve hours is enough to stop the menstruation entirely, whereas in this last case that I have just shown you the menses were resumed in a few months, and the patient is now pregnant. This result is to be expected, for in the ovaries of a woman near the menopause the follicles are fewer, more fully developed, and lie closer to the surface. The entire follicular equipment of the ovary is, therefore, more susceptible to complete destruction under the influence of radiation.

CLINIC OF DR. FRANK H. LAHEY

Boston City Hospital

OSTEOMYELITIS. GOITER (HYPERTHYROIDISM)

The following 2 cases are submitted because of their interest, and to illustrate the method of conducting the fourth year students' Surgical Clinic for Tuft's Medical School at the Boston City Hospital.

A list of typical major surgical conditions is made out, and each week one such case is assigned in the wards to a group of four students for thorough working up and presentation to the class in the surgical amphitheater on the following Wednesday morning at 11 o'clock, the clinic running an indefinite time until discussion, demonstration, and operation are over.

Under the direction of Dr. J. H. Shortell, of the hospital out-patient staff, a complete history is taken, which not only includes data relative to the condition for which the patient enters the hospital, but also investigates other sections for related or independent symptoms. We feel that history taking, particularly in surgical clinics, has become almost a lost art, and that it should be revived. This point is emphasized because we are impressed with the readiness with which surgical house officers arrive at a diagnosis and then write a history to prove it.

In the same way, *i. e.*, under direction, a complete physical examination is made, then checked up and criticized by Dr. Shortell or the house surgeon.

In conference with Dr. Shortell, an outline of all laboratory data or consultation with men representing special branches is prepared, and arrangements made with the various laboratories to obtain such data. After the accumulation of this material, it is included under the history, a brief differential diagnosis written by the group, and the entire report submitted to Dr. Shortell for criticism. It is then sent to the medical school and mimeographed, so that at the hour of the clinic copies are available for each student and for visitors.

At the hour of the clinic the report is read to the class, a medical stenographer supplied by the school being present. At the end of the report the discussion is taken up by Dr. Lahey, the case demonstrated, discussed, and operated upon, the operation explained, and gross pathologic material demonstrated. The remarks are preserved by the stenographer, transcribed, edited by Dr. Lahey, mimeographed, and copies returned to the students at the next exercise, to attach to the mimeographed report of the case.

Where consultation has been held with other departments, such as the blood laboratory, the *x*-ray department, the chemical laboratory, or the pathologic department, they are requested to discuss their findings before the class in order that these may be mimeographed and preserved with the notes of the case.

The case is returned to the ward after operation, and is followed by the group of four students either throughout the school year or until the patient is entirely relieved and free from symptoms.

During his stay in the hospital the patient is shown at each weekly clinic, with a report of his recovery, treatment, and complications. Microscopic sections of the material removed are provided by the pathologic department for demonstration at the next weekly clinic following its removal.

After leaving the hospital the patient is brought to the clinic from time to time by a member of the group of students having him in charge, so that a record may be made as to his complete, partial, or incomplete cure. These weekly reports, with remarks by Dr. Lahey, are recorded by the stenographer and supplied to the students to attach to each case to make it complete.

By this method each student has an opportunity to participate in the accumulation of all available evidence in a case. The entire class has the opportunity to hear the evidence, the students' differential diagnosis, and Dr. Lahey's discussion, to see the diagnosis as established by operation, to observe and have explained the steps of the operative procedure, to see gross pathology when demonstrable, to see microscopic pathology at the next exercise, and to see and follow the case to cure, partial cure, or failure.

OSTEOMYELITIS

Student's Report.—Name: Philomena S. Nine years. Serv. IV. Surg. Ward W.

Previous Admission.—August 1, 1920, on another service.

Admission Diagnosis.—"Septic elbow."

Present Illness.—Patient states she felt soreness in region of left elbow, without any history of trauma or sepsis. Gradually swelled, became red and very tender. Treated by a local physician, and had *x*-ray taken, which showed nothing. Sent in here for treatment.

Local Examination.—Left elbow markedly swollen, giving it the shape of a spindle. Swelling extends down as far as the fingers. Very tender upon pressure. Temperature 103° F.

Treatment.—August 20, 1920, operation. Through-and-through drainage. Pus obtained. Culture taken. Rubber drainage. Dry sterile dressing.

Flaxseed continued.

Preoperative diagnosis: Septic elbow.

Postoperative diagnosis: Septic elbow.

Culture from wound showed Staphylococcus aureus.

August 25, 1920, operation. Radius exposed. Holes drilled in bone. Little cavity found. No pus obtained. Rubber drainage. Dry sterile dressing.

Preoperative diagnosis: Osteomyelitis.

Postoperative diagnosis: Periostitis.

x-Ray No. 62,998 Bl. "Lateral view only. Dressing obscures bone desired."

Temperature gradually became normal and wound stopped draining. Granulation begun.

September 24, 1920. Temperature normal. Wound granulating. Boric ointment dressing. Little motion in elbow. Discharged relieved to Out-patient Department.

These notes are an abstract of the patient's previous stay in the hospital on another service.

October 6, 1920. Entered IV Surgical Service as a clinic case. Name: Philomena S., Boston, Mass., age nine years.

Born in Italy, coming to this country at seven years of age.

Chief Complaint.—Pain and swelling of left elbow.

Family History.—Father and mother living and well. Both born in Italy. Four sisters and one brother living and well. No family history of tuberculosis, insanity, cancer, diabetes, or hemophilia. No venereal history in parents.

Past History.—Patient was a full term baby, normal delivery, and breast fed. Walked, talked, appearance of teeth, etc., all within normal time limits. General health good. Best weight 55 pounds. Weight now 50 pounds. No mumps, pertussis, scarlet fever, rheumatic fever, chorea, pneumonia, typhoid, or malaria. Had measles three years ago and tonsillitis four years ago. Between the ages of three and six patient gives a history of suspicious "night cries." No other illness. No accidents. Operated on, at this hospital, a month ago for the same trouble she now has. No other trouble.

Eyes.—No disturbance in vision or any other trouble.

Ears.—No deafness, tinnitus, or discharge.

Nose.—No discharge or epistaxis..

Throat.—Has had tonsillitis. Occasionally has a sore throat.

Cardiorespiratory.—No dyspnea upon exertion. No preprecordial pain, palpitation, edema, vertigo, syncope, pains in chest, chronic cough, expectoration, hemoptysis, night-sweats, chills, or fever.

Gastro-intestinal.—Appetite good; all foods agreeable. Drinks moderate amount of water. No trouble in swallowing. No nausea, vomiting, indigestion, belching of gas, or heart-burn. Never jaundiced. Bowels regular without cathartic. Stools well formed and soft in consistency. No diarrhea. No black, tarry, or clay-colored stools.

Genito-urinary.—Micturition three or four times a day; does not get up at night. No polyuria, hematuria, incontinence, suppression, retention, frequency, or dysuria.

Neuromuscular.—No convulsions, mental changes, stiffness, paralysis, numbness, dizziness, fainting, anesthesia, or paresthesia.

Habits.—Does not drink tea or coffee.

Present Illness.—Temperature, 98° F. Pulse, 88. Respirations, 20. Blood-pressure, systolic 90; diastolic 60. It is stated that two months ago, without any history of trauma or sepsis, the patient suddenly felt pain in her left elbow. In three or four days the pain became more severe, and the elbow was swollen, red, hot to the touch, and tender upon pressure. Patient felt feverish. A local physician was called, who recommended hospital treatment. At this hospital the patient was operated on twice. A small cavity was found in the shaft of the radius and pus was drained. Almost two months after entrance patient was discharged, relieved, to the Out-patient Department. At time of discharge temperature was normal; the wound was granulating. Within a week after discharge draining began again. Patient re-entered on the IV Surgical Service. There is no history of any illness immediately preceding the onset of this trouble.

Physical Examination.—Fairly well-developed and nourished female child of nine years, up and walking about the ward, carrying left arm in sling, but in no apparent pain. Child is quite easily excited.

Head.—Symmetric, no exostoses or other abnormalities.

Eyes.—Conjunctivæ clear; pupils equal and regular; react to light and distance. No nystagmus, strabismus, or signs of hyperthyroidism. No ptosis.

Ears.—Hearing good. No discharge or tophi. No tenderness over mastoid region.

Nose.—No discharge or obstruction.

Mouth: Teeth.—Fair condition; all present; no pyorrhea alveolaris.

Tongue.—Clear and moist; protrudes in median line without tremor. Mucous membranes slightly pale.

Pharynx.—Slightly reddened. Tonsils very much enlarged. No membranes.

Neck.—No rigidity, glandular enlargement, or pulsations.

Chest.—Symmetric. Expansion equal. Normal in shape. No signs of rickets.

Lungs.—Resonant throughout. Vocal and tactile fremitus normal. No râles. Over apices, posteriorly, the expiratory murmurs are somewhat prolonged. Breath sounds otherwise normal.

Heart.—Apex impulse seen in the fourth left interspace 6 cm. to left of midsternal line inside nipple line. Right border 1 cm. Left border 6 cm. No shocks or thrills palpable. Sounds regular, clean, and of good quality. No murmurs heard at any valve orifice. P_2 equals A_2.

Pulses.—Equal; synchronous, and of good tension and volume. Pulse-rate, 86.

Abdomen.—Soft, level, and tympanitic. No masses felt. No spasm or rigidity. No hernia. Liver, kidneys, and spleen not palpable. No costovertebral tenderness.

Lymph-glands.—No posterior or anterior cervical, axillary, epitrochlear, or inguinal glands palpable.

Genitalia.—Negative.

Arms.—Right arm normal. Left arm: See *local*. No clubfingers.

Legs.—Symmetric and equal in length; no deformity.

Reflexes.—Knee-jerks present, equal, and active. No Kernig, Babinski, or ankle-clonus.

Skin.—Clear and moist. No eruption.

Osteomyelitis.—The acute onset with fever, the swelling, tenderness, redness, and loss of function prior to previous admission to this hospital, where operation on the left forearm showed a small cavity in the shaft of the radius, and the subsequent draining of pus, bacterial examination of which showed Staphyloccus aureus, all point toward osteomyelitis. The persistent discharge since then is another fact in favor of osteomyelitis, as are the *x*-ray findings.

From the preceding history, and the clinical and laboratory findings, corroborated by *x*-ray findings, we believe a diagnosis of osteomyelitis of the shaft of the radius and probably of the ulna, as well, is justifiable.

Despite the absence of any history of trauma, this condition possibly may have been preceded by trauma, and may be an extension from a periostitis following cellulitis.

The facts that the patient has enlarged tonsils and that there is a history of preceding tonsillitis and an occasional sore throat suggest that the tonsils may have been the local foci from which the infection spread, starting an acute process in the radius, resulting in osteomyelitis.

Patient brought in, etherized.

Dr. Lahey: You can see in this *x*-ray plate (Fig. 233) the osteomyelitic process involving the entire radius. This process having involved the entire shaft of the radius, it will be completely, and in a measure is now, surrounded by beginning new bone. Soon the old shaft will be but a foreign body, acting as such and delaying healing until it liquefies and is discharged through sinuses or removed by operation. We propose to do that now, that is, remove the entire shaft of the radius, depending upon the preserved periosteum to regenerate a new radius. We do this, first, to shorten convalescence, and second, that the old shaft may not interfere with the production of a strong new radius.

We now make an incision along the radial side of the forearm down to the radius, carefully controlling all bleeding so that a dry field may be had. This incision extends from the wrist to the upper epiphysis of the radius. The periosteum is not incised throughout the length of the radius, and you can all see its thickness and beginning deposit of bone in it. By means of the sharp periosteal elevator the entire layer of periosteum is raised from the old shaft, taking care that the genetic layer of bone cells close to the shaft is raised with the periosteum, and not

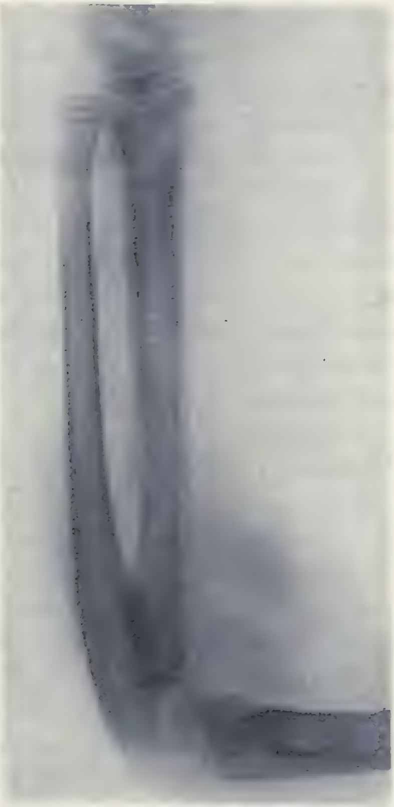

Fig. 233.

left behind with the shaft. This elevation is now carried from the lower end of the radius to its upper end and completely around it. We now gently break off the upper end of the shaft, where it readily separates at the epiphyseal line, and in the same way break off the shaft at the lower epiphyseal line. We have now excised the entire old shaft and you may see here the gutter made by the thickened remaining periosteum. We again carefully control bleeding, insert Dakin's tubes in this cavity, and now place the arm and hand in plaster, taking pains, as you see, that the hand is held in such relation to the wrist that the remaining radial periosteum is kept in proper extension.

The important facts in connection with this case are that, particularly in children, practically all spontaneous infections about joints are to be strongly suspected of originating from an epiphysitis of hematogenous origin. In this type of lesion, the epiphysis being close to joints, there results a swelling which extends about the joint, and to the inexperienced frequently suggests a joint infection. Many of the cases of this type which come into this hospital are sent in with that diagnosis. Remember that in children osteomyelitis originating as an epiphysitis is many times more common than a joint infection.

In such an early case of epiphysitis it is important also to know that the *x*-ray findings are negative, and that the decision whether to drain the bone or not must be based upon the clinical evidence only. It is only by wide, early, and adequate exposure and drainage of the bone that involvement and destruction of the entire shaft, such as have occurred in this case, can be avoided.

It is important also to realize that a complete removal of the diaphysis in a case such as this should not be undertaken unless it is evident that the osteomyelitic process has involved the entire shaft of the bone, as, indeed, is usually the case with the exception of those rare instances in which there is a localized pus process which has become walled off and surrounded by dense bone, then known as bone abscess or Brodie's abscess, and requiring only complete sterilization of the cavity and removal of a considerable portion of the wall.

Furthermore, removal of the shaft should not be undertaken until it is evident by *x*-ray that a fair start toward the development of a new shaft has already been made by the periosteum surrounding the old one. This is less important in bones such as the fibula or radius, since they are not the sole support of the extremity, as is the case in the humerus. In that bone, however, removal of the old shaft cannot safely be done until the involucrum bone is of sufficient denseness to support itself and maintain the normal length of the bone against the traction of muscle connecting it with other and unaffected bones.

In the removal it is important, as I have already stated, that the thickened and bone-developing periosteum should be carefully raised from the old shaft in order that none of its bone-forming layers of cells are detached from it and removed with the old shaft. Another important point is that care be taken that the diaphysis only be removed and the epiphyses left behind uninjured and able to function in their capacity for controlling distance growth in the new shaft. If the proper time is selected for the removal of the old shaft, by gently moving the shaft and head they may be made separate very readily at the epiphyseal line.

It is extremely important, if the new growth of bone is still so limited that the periosteum is still flexible, to apply splints or plaster in such a manner that the extremity is maintained in its full extension.

We will show you Philomena from time to time, and you will have an opportunity of observing by *x*-ray and palpation the development of her new radius.

October 13, 1920.

Dr. Lahey: The little girl, whose radius we removed last week, is here; the *x*-ray, being taken through the plaster, of course, is not very good, but it shows the ulna and the absence of the radius. They will bring in the little girl and show you the arm while we are scrubbing up for this case. I have not done this dressing myself, but under Dakin's solution the granulations, as you will see, are bright, clean, and healthy.

November 24, 1920.

Dr. Lahey: You will recall Philomena, whom you have seen many times, whose entire radius we excised as a sequestrum, leaving the shell of periosteum after the excision. When seen by you before the bone had not begun to develop so as to be seen by *x*-ray. We will show you the arm in the internal angular splint, and here by *x*-ray (Fig. 234) is the radius with definite growth of bone. Eventually this radius will be developed from the periosteal shell which was left behind. At the present time the growth of the bone is diffuse, but as soon as the bone deposit is greater, it will solidify and take on the form of a new radius. In the meantime the hand is held by a splint to prevent deformity of the forming radius. Here you see the irregular outline and the epiphyses left behind at the lower and upper ends; this means that the articulating surface will remain unaffected. She should have good rotation because the end of the head of the radius was not removed, and should also have good flexion at the wrist. The wound is gradually closing in, and I doubt if we shall be able to close it by secondary suture, but inasmuch as it remains clean, the granulations healthy and the bone developing, we are quite satisfied.

December 1, 1920.

Dr. Lahey: Here is Philomena again; she shows a tendency to swing her wrist over, which must be corrected, otherwise the radius will be shortened. We must put an apparatus on which pulls down on the radius, and we can do that best with an internal angular splint and a pistol-grip splint.

This is the *x*-ray plate[1] of Philomena's arm, showing considerably more bone regeneration than the previous one.

December 22, 1920.

Dr. Lahey: This is a later picture (Fig. 235), taken yesterday, of Philomena, and you see the further ossification of the radius taking place; irregularly, to be sure, but eventually that irregularity will smooth out, so that at the end of a year Philomena will have a fairly smooth radial shaft. Notice, also, that the epiphysis is intact on the upper end, and the epiphysis on the lower end is also intact, so that the distance development in the shaft should not be interfered with. The student who has had charge of Philomena's case reports that a small spicule of bone was removed from the sinus the other day; in addition, those of you who are near will see a thickening of the periosteum of the ulna which is reported by the x-Ray Department as osteomyelitis of the ulna. I am unable to say at the present time whether that will result in destruction of the ulna also or not; I should say probably not. She now has the radius replaced by solid bone from one end to the other. You see she has a little rotation in

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[1] To avoid repetition, not all of the *x*-rays are shown.

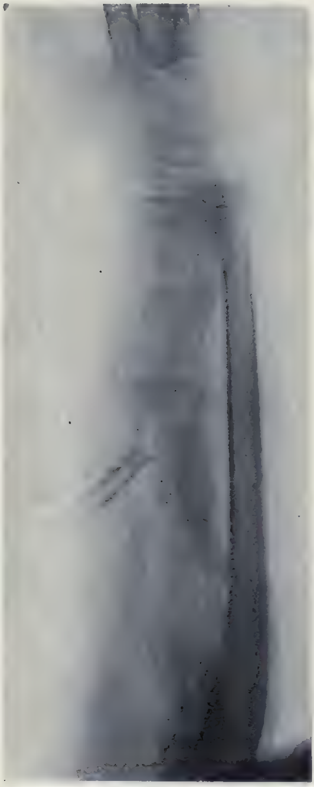


Fig. 234.

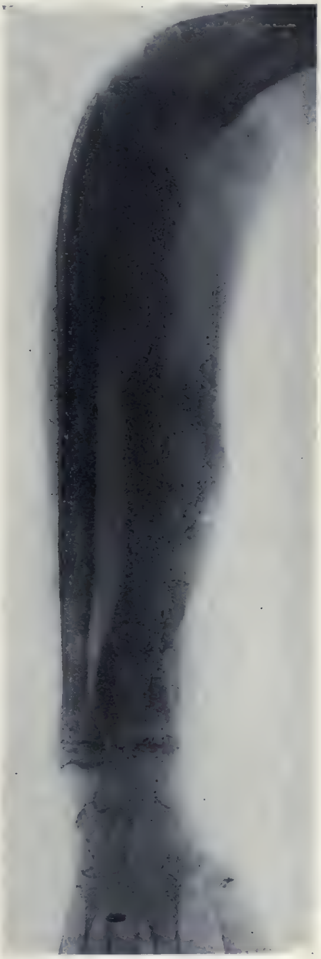


Fig. 235.

her radius. You can feel distinctly the entire shaft of the radius firm, as a solid piece of bone running from the upper to the lower epiphysis. There are, as you see, three small sinuses left, which granulate, and I believe that within a short time, a few weeks, these sinuses will be closed, and then it will be only a question of time for the radius to smooth out and be re-established as a completely regrown radius.

January 5, 1921.

DR. SHORTELL: They have been taking the temperature of this patient in the Out-patient Department every morning, and it has been normal. There has been no flare-up. The position of the bone is very good. You can see now that she has formed a new radius which is absolutely firm. The granulating area on that wound will be burned down with silver nitrate. She can flex a little bit beyond a right angle and can extend her arm to about 30 degrees of normal. There is no apparent osteomyelitis of the ulna.

February 2, 1921.

STUDENT: Since you last saw Philomena she has been in the Convalescent Home at Wellesley, and then came back to the Out-patient Department. While she was out at Wellesley they took off the pistol-grip splint and put on an ordinary anterior splint.

DR. LAHEY: Can you see this little round shadow by *x*-ray (Fig. 236) in the bone? I question if this is not a sequestrum and this a cavity, particularly since at the lower end of the incision Philomena has, as you see, a small granulating wound which has persisted, while the remainder of the incision has entirely healed. The student in charge of this case states that the *x*-Ray Department say that it is an artifact, particularly if the entire diaphysis has been removed. You all know that the entire diaphysis has been removed because we have all seen it from one epiphyseal end to the other, and had it in our hands. The reason they ask this is because this portion looks like cortical bone. It is not cortical bone, but is entirely new bone. The entire shaft is regenerated and the distance growth is perfect in Philomena's arm. Her wrist is normal, its line is perfect. The rotation is fair, due to the fact that the head of her radius was left, being the epiphyseal end. The flexion covers a few degrees—I should say ten—beyond a right angle; the extension is perhaps 50 per cent., from a right angle to full extension. I see no reason, since the joint was not involved in the process, why she should not eventually get full flexion and extension and almost full rotation.

You will recall that in a previous *x*-ray there was a question of osteomyelitis of the ulna, due to periosteal thickening and reaction. This has practically disappeared in this plate, there being almost no periosteal thickening.

Notice that in the *x*-ray there is a rough, ill-shaped radius, but time will take care of the roughening in this case, and will eventually produce a perfectly smooth radius. If you think these surfaces will not smooth out, recall the overlapping fragments on a femur. You will occasionally see lipping of the two ends of a femur so (illustrating) that the ends will catch and unite, and on *x*-ray there will be a jagged irregular callus, yet at the end of a few years the bone is straight. The ability of nature to smooth off rough ends and to straighten out irregularities is remarkable, particularly in growing children.

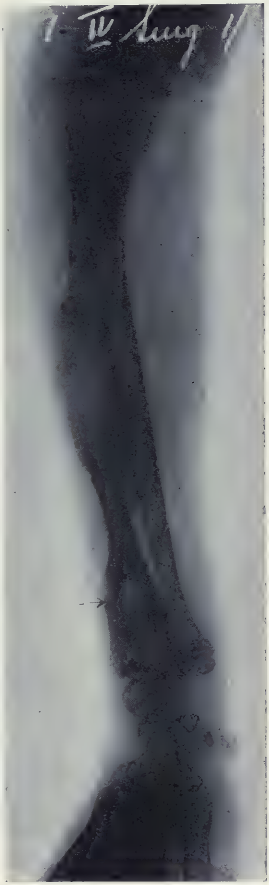


Fig. 236.

Philomena should come back now for massage and manipulation, though she no longer needs to wear a splint.

February 16, 1921.

STUDENT: The last time Philomena was here the splint was taken off, and she was coming back to the Out-patient Department for massage and passive motion. She has as yet very little more motion than she had at the last time she was shown, except in the fingers, where she has a considerable degree more motion. There have been no more *x*-ray plates taken since the last time.

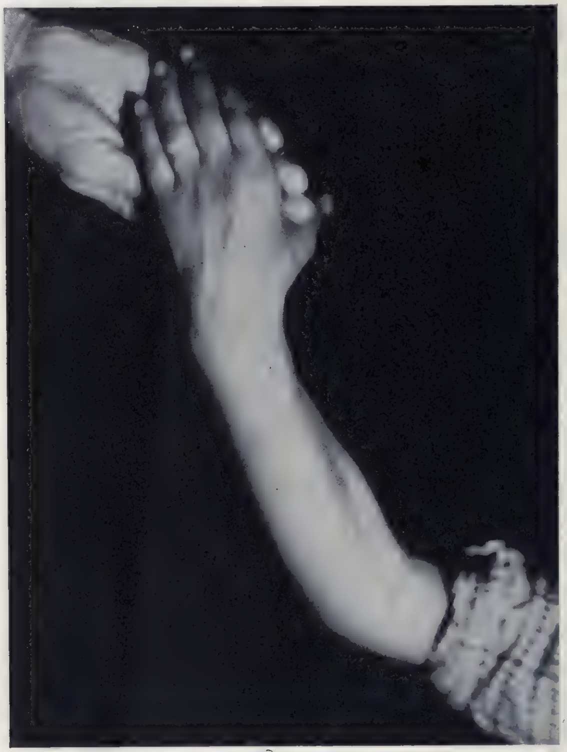


Fig. 237.

DR. SHORTELL: The last time Philomena was here she could not grasp anything—her grip was poor. Now she has a fairly good grip, the motion in her wrist is pretty good, and her elbow motion is about the same as it was at the last time. She holds her arm half-way between supination and pronation. She cannot pronate at all, but can supinate. This sinus is still unhealed, and, if you remember the x-ray plates, that is about the place where she had that questionable sequestrum. The best way to treat her is to let her use the arm as much as she can, and in that way she will gain motion.

March 2, 1921.

DR. LAHEY: Here you see Philomena again, and there is little to add except that she still has the sinus, which I think proves pretty definitely that the shadow which we saw is a cavity containing a small sequestrum. Unless this closes very soon, we will give her anesthesia, open the sinus, and remove the sequestrum, which is no larger than a BB shot.

She has now more flexion and 50 degrees of extension from a right angle. She has fairly good rotation, good motion in her wrist, and you can see that she has good symmetry of her forearm. The irregularities of the radius are beginning to smooth out, and she has a firm, strong radius.

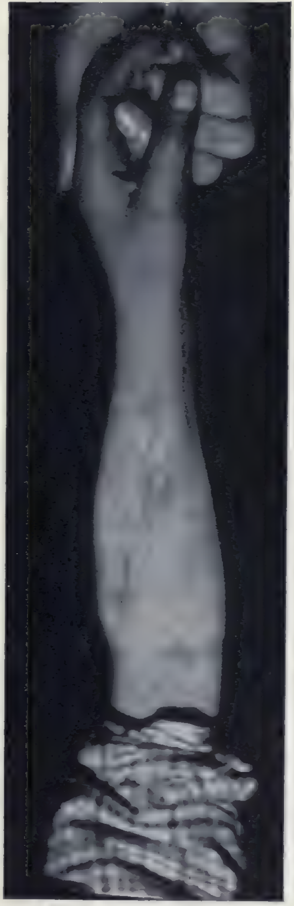


Fig. 238.

Figures. 237 and 238 show the appearance of the arm at this time.

INTRATHORACIC GOITER (SECONDARY HYPERTHYROIDISM)

Student's Report.—November 24, 1920. Name: Irving M. P. Service IV, Ward P.

Chief Complaint.—Weakness, breathlessness, and sweating on least exertion.

Family History.—Father died of tuberculosis at the age of thirty-two. Mother living and well. One sister and one brother living and well. No history of rheumatism, gout, hemophilia, insanity, cancer, or goiter.

Marital History.—Married twenty-nine years. One son living and well. Wife has had no miscarriages.

Past History.—Born in Richmond, Vt. Age fifty-eight years. Has lived in New England most of life. In childhood had measles, whooping-cough, and mumps. No chicken-pox, smallpox, K. L., tonsillitis, chorea, rheumatism, typhoid, scarlet fever, pneumonia, malaria. Present weight 115 pounds. Loss of weight gradual. States heart has always been rapid.

Trade.—Wood-worker in piano factory.

Habits.—Moderate use of alcohol. One cup of coffee, two cups of tea daily. Formerly six cigarettes, lately twelve cigarettes daily.

Injuries.—When twenty years old received a glancing blow from an axe on back of head; unconscious several hours. Had three middle toes, left foot, cut off by axe at another time. States memory has always been poor. Has had dull headache, especially at night, most of his life.

Present Illness.—About twelve years ago noticed loss of energy, felt himself losing strength. Was grateful when he had an opportunity to rest. For the past twenty-five years has had dyspnea and palpitation at times on slight exertion. No cough or expectoration. For some years has had asthmatic attacks. Does not know cause. Finds it hard to get to sleep; wakes easily; averages five hours' sleep. No vertigo or fainting. After lying on his back for some time experiences difficulty in enunciation, which disappears after a few words; when in an upright position this does not happen. Voice at times "breaks." Weakness and breathlessness have gradually increased. Perspires very easily. Thinks he can stand cold weather much better than formerly. Was once very sensitive to cold. Has had a few spells of dyspnea lasting two or three hours, some half a year ago, which were nearly fatal, he thinks. Has no difficulty in swallowing. Appetite good. Bowels regular. No nausea or distress. No jaundice. Nocturia 1; diurnal 2. No dysuria, hematuria, or pyuria. For the last few years he has had periods of lassitude lasting from two to four weeks. Above symptoms have gradually increased. Has had no pain, hemoptysis, night-sweats, colic, or diarrhea.

Physical Examination.—Well-developed and fairly nourished white man, lying comfortably in bed; conscious, rational, and in good spirits. No apparent mental disturbances. On entrance, temperature 98.8° F. Pulse 96. Respirations 24.

Head.—Symmetric; slight protuberance of left occiput. No exostoses.

Eyes.—Wears glasses to read. Marked arcus senilis. Scleræ clear. Pupils regular; react to light and distance. Right pupil much smaller than left. No photophobia, nystagmus, lacrimation, lid lag, or palsy. Slight exophthalmos and tremor of lids. Conjunctivæ normal. Right eye, normal vision. Left eye, vision weak and definition poor. Von Graefe's sign absent. Right eyelid droops lower than left when closed. More tremor of right eyelid than of left.

Ears.—Hearing much better in right than left ear. No discharge, tophi, or mastoid tenderness.

Nose.—No deformity; no discharge. Slight obstruction to breathing due to slight congestion in right inferior turbinate. Many hard colds. No epistaxis.

Mouth.—Mucous membrane normal. No herpes or fissures. Tonsils normal. Tongue coated, yellowish, and fissured; protrudes in median line; some tremor. No ulcerations. Teeth gone. Upper and lower plates. No sore throat. Hoarseness at night.

Neck.—Visible pulsations, more marked on right. No tracheal tug. Cervical glands not enlarged. No rigidity. Larynx displaced 1 inch to left. Right lobe of thyroid gland greatly enlarged. Apparent boundaries by palpation, upper border at lower level of thyroid cartilage. Right border of anterior margin of sternomastoid, and extending below the clavicle. The left lobe seems to be somewhat enlarged, but owing to the displacement of the trachea to the left this enlargement is probably more apparent than real. In swallowing, the palpable portion of the gland forms a distinct bunch on the right, which rises and falls. There is no pain, tenderness, or redness over either lobe. The left lobe is firm and elastic. Pulsation palpable through tumor. The surface is smooth.

Skin.—Good texture, warm, and moist. Slight papular rash on abdomen. No jaundice or pigmentation.

Thorax.—Symmetric. Expansion equal and regular. Back: spine negative.

Lungs.—Resonant except for area of dulness below right clavicle extending to second rib. Normal vocal and tactile fremitus. Normal vesicular breathing. No râles. Respiration 25.

Heart.—Upper border not made out. Right border 3 cm. from median line. Left border 8 cm. from median line. Apex-beat felt as thrust at sixth interspace just outside midclavicular line. Sounds are regular. First sound at apex accentuated. No murmurs.

Pulse.—Regular and fair volume. Radials synchronous and of equal force. Rate 96.

Blood-pressure.—Systolic 125. Diastolic 75.

Capillary pulse in lips, not observed under nails. Throbbing in finger-tips. No venous pulse in veins of hand.

Abdomen.—Symmetric. No spasm, masses, ascites, or edema. Fulness and tension normal. No scars or tenderness. Pulsation from heart impulse seen and felt in costal angle. Liver, gall-bladder, and spleen not palpable. No herniæ or inguinal gland enlargement.

Extremities.—Rapid fine tremor of fingers on extension. Tibiæ smooth, no varicosities or ulcers; old carbuncle scar. No edema.

Neuromuscular.—No twitching, spasm, anesthesia, paresthesia, or ataxia. Has slight general muscular tremor. Knee-jerks equal and increased. No ankle-clonus, Babinski, or Kernig. Forehead wrinkles freely on looking up.

x-Ray (Fig. 239).—Shows a circular mass covering thyroid area extending slightly above and below the clavicle. Boundaries: lower limit at level of second costal cartilages, extending from midline on right about $5\frac{1}{2}$ cm.; on the left about $4\frac{1}{2}$ cm. Outline of mass lost above. The trachea shows displacement about 3 cm. to the left.

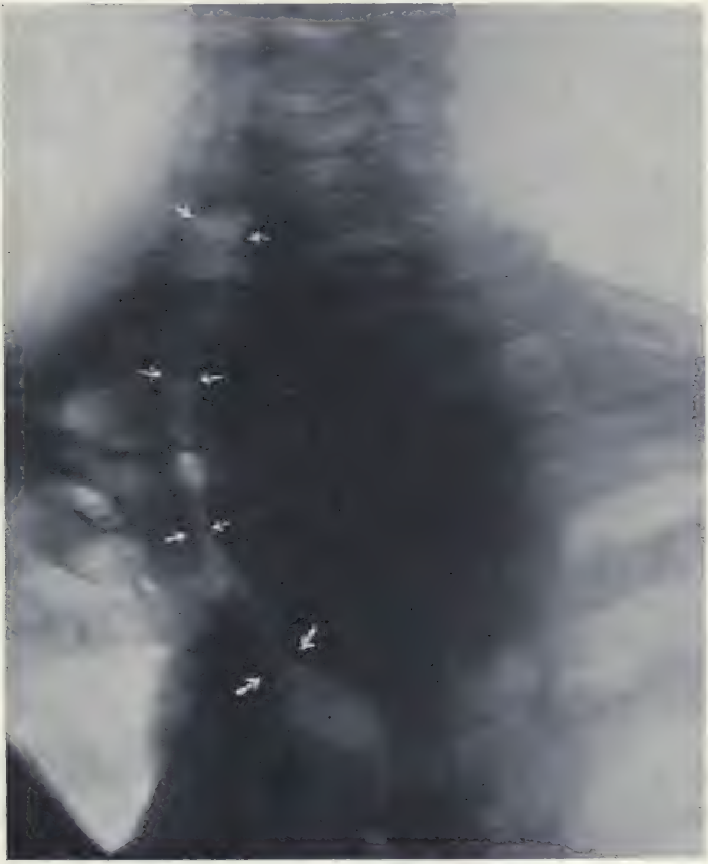


Fig. 239.—Note marked deviation of the trachea with narrowing, as shown at operation. Note also shadow and outline of intrathoracic mass.

Laboratory Findings:

Urine: Amber, acid. Specific gravity 1026.
Sugar 0, albumin 0, sediment negative.
Wassermann: Negative.
Blood: W. B. C., 5800 differential.
R. B. C., 4,848,000: Poly. leukocytes, 61 per cent.
Lymphocytes, 28 per cent.
Large lympho., 10 per cent.
Eosinophils, 1 per cent.
Smear normal.
Basal metabolism: Nov. 5, 1920 plus 56.2 per cent.
Nov. 17, 1920 plus 66.1 per cent.
Nov. 24, 1920 plus 62.4 per cent.

Diagnosis.—Intrathoracic goiter with secondary hyperthyroidism.

Discussion.—Besides the four cardinal signs—tachycardia, exophthalmos, gland enlargement, and tremor—we find the disease making slow headway over a long period of years. There are both pressure symptoms and those due to overactivity of the gland.

We find also dyspnea on slight exertion, free perspiration, weakness, emaciation, up-and-down movements of tumor mass on swallowing, and we are unaware of any other disease giving such a symptom-complex except intrathoracic goiter with secondary hyperthyroidism.

Dr. Lahey: This case, from the discussion, is undoubtedly a case of hyperthyroidism having the clinical symptoms of hyperthyroidism—goiter, tachycardia, tremor (does he have the exophthalmos?—"very slight"), slight exophthalmos, nervousness, loss of weight, dyspnea, free perspiration, weakness—myasthenia is a characteristic symptom of hyperthyroidism—and increased basal metabolism. For these reasons the patient has hyperthyroidism. Because the tumor descends into the thorax, as shown by the *x*-ray, the goiter is in the chest, and is intrathoracic. What goiters are intrathoracic? Colloid goiters, cystic goiters, and adenomata of the thyroid. Of all types, the most common intrathoracic goiter is the adenoma, and from the symmetric outline it is probable that this is an adenoma of the thyroid which has descended into the chest. How do we have also hyperthyroidism? There are two types of hyperthyroidism —primary and secondary. Primary hyperthyroidism is the hyperthyroidism which used to be known as exophthalmic goiter, in which there is a symmetric enlargement of the thyroid, and the disease in this type is due to overactivity of the cells throughout the gland. That is primary hyperthyroidism. Secondary hyperthyroidism has all the symptoms of primary hyperthyroidism, but the cause is different. It is the result of activity of the cells in the adenoma, the cells in the thyroid gland itself being only normally active. Therefore the treatment is different. The surgical treatment of primary hyperthyroidism must consist in the removal of at least four-fifths of the entire thyroid gland to accomplish a cure. The surgical treatment of secondary hyperthyroidism need be only the removal of the adenoma itself because it is the cells within the adenoma which are overactive, and produce the symptoms. In the case of secondary hyperthyroidism surgical cure results from removal of the adenoma. Therefore, this is a case of secondary hyperthyroidism in an adenoma of the thyroid within the chest, as proved by the shadow within the chest—here is the outline of the growth on the *x*-ray plate—and by the deviation of the trachea. Those of you at a distance even can see on the *x*-ray plate here the shadow of the intrathoracic mass. The trachea should be straight down in the midline, and here is the trachea pushed over to the left, showing it to be curved out to the left by the pressure of the adenoma. This, then, is an intrathoracic goiter with secondary hyperthyroidism.

How do goiters become intrathoracic? If you will recall the anatomy of the neck, I think you will understand. First of all, the isthmus of the thyroid rests on the tracheal rings over the upper thoracic aperture (Fig. 240), pressed on by the anterior muscles of the neck, with nothing to support it and prevent it going down into the chest. An adenoma develops here in the lower pole of the thyroid, and ascends and descends with each act of swallowing because the thyroid gland moves with deglutition; that means that there is a constant tendency for the adenoma to mold itself a bed in the downward direction. You will recall that the thyroid is covered anteriorly by the sternohyoid, sternothyroid, omohyoid, and sternocleidomastoid. Therefore there is a constant pressure inward, and with swallowing a downward pressure on the thyroid; so there is a constant tendency for an adenoma arising in the lower pole to be pushed down into the chest. You will remember that the chest narrows toward the upper thoracic aperture, so that after a portion of the goiter passes the superior strait, to so designate the upper thoracic aperture, and then enlarges, the adenoma is pulled or sucked down into the chest until finally it is wholly within the chest.

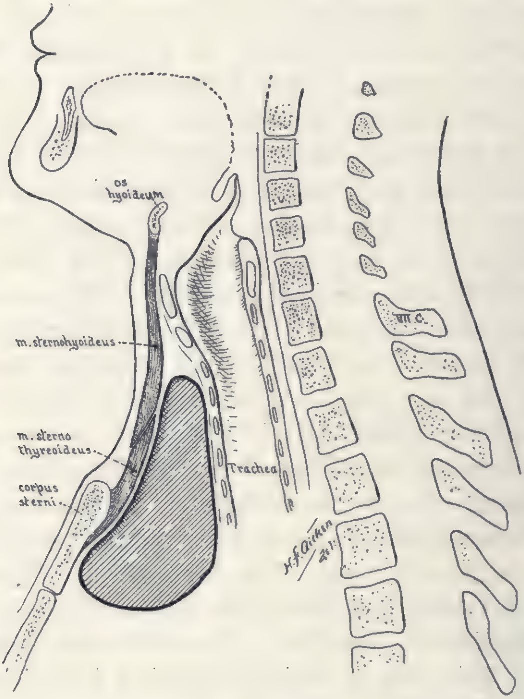


Fig. 240.

The first symptom is usually respiratory obstruction, increasing as the tumor increases in size and presses upon the trachea; such tumors deviate the trachea and often collapse it. If you look down into the trachea from above you find the trachea dented or collapsed instead of being round, and these obstructions produce respiratory difficulty varying from slight dyspnea to complete obstruction of breathing, necessitating operation as an emergency, because of impending suffocation from complete respiratory obstruction.

Therefore, in all cases in which the thyroid is suspected of being in the thorax, one should be especially suspicious whenever there is respiratory difficulty. *x*-Ray plates should be taken, and the intrathoracic shadow and the deviation of the trachea looked for.

Basal metabolism: As you know, the thyroid gland is the gland which controls metabolism more than any other gland in the body, and, as you also know, metabolism—basal metabolism—represents the oxygen combustion necessary to life; and all body functions are dependent on oxygen combustion for their maintenance. Therefore, if you know how much oxygen per square meter of body surface per minute the individual should consume to be normal, and if you know how much that person actually consumes, the difference between the two represents increase or decrease in basal metabolism.

This patient started with an increase in basal metabolism of 56.2 per cent., rose to 66 per cent., and dropped to 62.1 per cent. What does that mean? Approximately, basal metabolism is indicative of thyroid activity, but only approximately, you cannot say accurately; but 56.2 plus means approximately that the thyroid is secreting 56.2 per cent. more than normal, and therefore we may estimate the patient's sickness in terms of metabolism figures. But do not make the mistake that this is absolute; you can only say that the patient is approximately 56.2 per cent. toxic.

We have found in a number of thyroid operations that this is a high degree of toxicity, that toxicity of this degree produces a dangerous condition of the heart, and that complete operation in cases with basal metabolism rates as high as these are dangerous. Therefore to remove the whole gland at this stage would be dangerous. So we are going to ligate both thyroid poles—artery, vein, and sympathetic nerve. The nerve comes from the superior cervical ganglion and goes down with the artery and vein and innervates the gland. We shall interrupt the blood-supply by about half, inasmuch as the blood-supply comes from the superior and inferior thyroid arteries. If we tie in the nerves we shall interrupt the innervation of the gland by about one-half also. This usually accomplishes a gain in weight, a decrease in metabolism, an improvement in symptoms, and allows the patient to come to the final operation for removal of the thyroid gland or adenoma in very much better condition. Now how shall we know that the patient is in better condition after this operation? We will do metabolism tests every two weeks; then if he has a drop in metabolism and a gain in weight, and is improved generally, we shall continue, and when we have found a maximum drop, we shall take him into the hospital for his final operation—removal of the adenoma from his chest. So we will tie the poles this morning, and allow you to see him from time to time and keep you informed as to the metabolism rate, and, when he is ready, take the thyroid adenoma out of the chest.

Now as to the operation: Hyperthyroidism is a peculiar disease. Any psychic stimuli raise metabolism, overactivate the thyroid, increase the pulse-rate, and increase the danger in every way. Therefore we should get these patients to the operation with just as little excitation as possible; and we have therefore given this man—we have established a routine to manage these cases—$\frac{1}{4}$ grain of morphin and $\frac{1}{200}$ grain of scopolamin hypodermically two hours before operation, repeating this dose one hour before operation; as a rule these patients get to the operating table drowsy, sleepy, and many of them do not even remember that they have been operated on at all. Some of them recall being put on the truck, and some of them recall a little about the operating-room. Many of them cannot recall the details of the operation at all. In others, the preliminary drugging is not as successful, and they can recall every detail up to their entrance into the operating-room. They come to the operating-room, are prepared, and then gas oxygen is given, because we do not believe in doing these operations with a local anesthetic. They are excitable, apprehensive, and the pulse goes up on the slightest stimulation; accordingly, we believe that they are safer if asleep and not psychically stimulated.

Gas oxygen used to be considered the safest anesthetic in surgery; it used to be said that you could not kill patients with gas oxygen. We now know that this is not true. In fact, we believe that gas oxygen is one of the most dangerous of anesthetics in the hands of a novice. It is, however, very safe in the hands of an expert. For these patients it is the ideal anesthetic, as they can be put under very quickly and come out very quickly, as with the preliminary drugging they require very little nitrous oxid in proportion to oxygen. Dr. Sise gives all these anesthesias for us, because once the anesthesia is started, we must depend on the anesthetist for information as to the condition of the patient. He tells us the patient's pulse-rate, blood-pressure, and general condition; if the patient is failing, we depend on him to stop us and send the patient back to bed, leaving us to finish the operation at another time. Therefore the anesthetist must have constant experience in judging the condition of these thyroid cases.

Operation.—We will drape the patient here so that you can see the method. At the present time we do not ordinarily operate cases of hyperthyroidism in this hospital for the reason that we have undertaken to treat here, for two or three years perhaps, all suitable cases of hyperthyroidism by *x*-ray in order to ascertain, if possible, the value of *x*-ray treatment, while at the Deaconess Hospital we maintain a thyroid clinic where we operate practically all cases of hyperthyroidism; but this man, of course, is a mechanical problem, primarily, because his goiter is causing pressure and will cause more and more pressure. Therefore, we treat him surgically. You see the adenoma ascending out of the chest as he breathes. Here is a relatively small goiter showing, but from the *x*-ray he has a thyroid as large as an orange. By percussion you can appreciate the dulness over the upper chest, showing the adenoma to be down in the chest. Now it will not be easy to find the pole of this thyroid, because it is pulled down into the chest. We are using 2 per cent. novocain in addition to gas.

Failures in this operation are due to the fact that inadequate exposure of the superior pole is made, and not all of the pole tied. We find the inner border of the omohyoid and the pole directly under it. His pulse, which started at 155, has dropped to 120, which shows that he will be able to stand the operation all right. Now we dissect down on the inside pole until we come to the trachea; we are next behind the pole on the inside, and we dissect down to the internal jugular on the outside. Now we have the upper pole lifted and exposed on the inner side and on the outer side, and we must be careful not to pick up the internal jugular. I pass a ligature around the pole. Here are the artery, vein, and nerve, all included; notice that I am taking care not to include the jugular. Here is the pole with the ligature passed around it, tied tightly. We drop the omohyoid back over the pole.

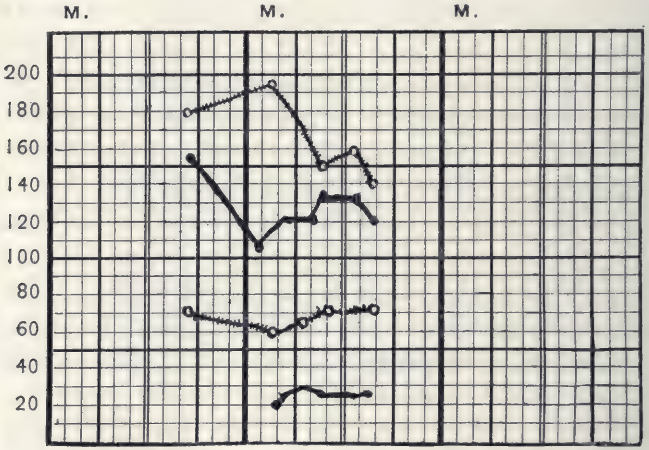


Fig. 241.—Pulse, blood-pressure, and respiration chart made by the anesthetist during the ligation. The wavy lines indicate blood-pressure; the solid black lines, pulse and respiration. Note the moderate pulse-rate throughout, indicating good tolerance of the operative procedure.

Dr. Sise, during the operation, keeps a pulse chart; the pulse, blood-pressure, and respirations are taken and recorded on this chart every five minutes. Now if the patient were not in good condition we should stop and send him back to the ward, and at the end of ten or twelve days have him back again and tie the other pole. His blood-pressure at this moment Dr. Sise reports is systolic 150, and diastolic 70; he cannot be in any great shock, so that we can proceed with the ligation of the second pole. Some of these cases do not react to ligation; possibly this man may be one of them. We have a record of how he has acted during the time he has been under the anesthetic, and from that we will be aided in judging how he will stand the second operation. He has had a trial test, so to speak. We use this same method of charting in all surgical cases, so that we may have a preliminary warning of shock. The great danger without this record, of course, is that the patient gets too far in shock before we know it (Fig. 241).

This man is still profoundly asleep. He will go back to the ward and sleep four to six hours. That accomplishes just what we want: first, drowsiness as he comes to the operation; second, ease of anesthesia; and third, he goes back with a period of sleep which carries him through the postoperative stage. He gets preliminary rest, ease of anesthesia, and postoperative rest, which are what these patients need.

December 8, 1920.

Dr. Lahey: He tells me he became conscious at 6 P. M. on the day of the operation, Wednesday afternoon, after the operation. You will recall that we said he had preliminary drugging with scopolamin and morphin, and that the advantage of preliminary drugging was that he would come to the operating-room drowsy and only partly conscious of what was going on around him. Did you know anything about what was going on, Mr. P.? He says he knew nothing and did not realize that he was in here. So we accomplished the purpose for which we gave him preliminary drugging, for he did not know he had been in here, and Mr. W., who represents the group of students in charge of this case, reports that he became conscious at 6 P. M. Therefore he had rest before coming here and a long period of rest after he left the operating-room.

Student reporting on case: He had no nausea. He was anxious to get up, and had to be restrained. He ate the next morning, and on the second day after the operation got out of bed. He felt weak, however. His pulse, as I found it, was about the same as before; the tremor was about the same. He said he felt about the same and that it hurt him to swallow at first until after he exercised the throat muscles. On the 27th (three days after the operation) I found the pulse the same. He says he caught cold on Sunday, and the temperature went up to 100° F. on Sunday and on Monday to 101° F. It was normal yesterday noon. He was back on the regular feeding again Tuesday. His stitches were taken out, and outside of a cold he feels all right. The pulse was 96 yesterday. This morning the temperature was normal and the patient feels better.

Dr. Lahey: He has had a follicular tonsillitis. As you see here, his stitches are out. Hold out your hands, please. He still has a tremor, but a good deal of the tremor has gone. His pulse remains about the same—100 to 110—and he is now ready to leave the hospital. He thinks he will go tomorrow, and he will report here every two weeks until his basal metabolism has reached its lowest point; then we will remove his intrathoracic goiter.

January 5, 1921.

Student's report:

Re-entry into hospital.

Previously operated on December 1, 1920. Double pole ligation. Left hospital December 9, 1920, and stated he "felt fine."

Sleeps about nine hours a night. Appetite good. Not as ravenous as before operation. Breathes easier. Tremor has been much less since operation. Sweating also less and exophthalmos seems less. Has gained 1 pound in weight.

Basal metabolism on December 23d plus 51.

On January 2, 1921 felt poorly and began to cough. Breath short when coughing. Last admitted January 3, 1921. Pulse

90. Temperature 98.6° F. Respirations 20. Blood-pressure: systolic 150, diastolic 72.

Physical Examination.—Tremor of fingers and tongue is less. No appreciable change in size or consistency of goiter. Exophthalmos and sweating less. Pulse lower than before operation, regular, steady, and full.

Throat shows some congestion. Complains of a slight cough, which he says is improving. He is in good spirits and says he is much stronger than before operation, and his nervous poise is much steadier.

January 4, 1921. Urine: Specific gravity 1020.
Albumin 0.
Sugar 0.3.

Patient brought into the amphitheater under gas oxygen.

Dr. Lahey: This man is now in sufficiently good condition, so that we feel he will endure the removal of his intrathoracic goiter. He has not shown the drop in metabolism rate that we would like, but has shown sufficient clinical improvement so that we feel we can complete his operation with safety. Inasmuch as the problem in this case is largely the mechanical one of removing this mass which is causing tracheal pressure, we do not feel that there is anything to be gained by further delay. If he were a case of primary hyperthyroidism, and we were still unsatisfied with his present condition, we could perhaps further improve it by continuing the ligations by tying both his inferior thyroid arteries on the inner borders of the scaleni antici. Since this goiter is almost entirely within the chest and the inferior thyroid arteries therefore cannot be approached, nothing further in a preliminary way can be done; we must therefore proceed with the removal of the mass.

The collar incision is made as in the operation for primary hyperthyroidism, the sternohyoid and sternothyroid are separated from their neighbors in the middle line, cut on both sides between clamps, and the top of the intrathoracic mass exposed. My fingers are now gently sweeping around the mass in the superior mediastinum, while I am taking great care that they are kept in the line of cleavage between the surface of the goiter and the layer of condensed connective tissue which surrounds it. This is extremely important, as it is by this measure that the pleura, the thoracic duct in left-sided masses, and the recurrent laryngeal nerves are pushed away from the surface of the mass. No attempt is being made to pry the mass out of the chest and deliver it until it lies entirely free in the superior mediastinum.

It is now free and by one finger beneath it on each side it is gently and by pressure from below forced out of the chest until, as you see, it is entirely out and lying here upon the neck, attached only by its blood-supply and some connective tissue. We cannot be certain, owing to the stretching and distortion of the recurrent laryngeal nerve which must necessarily accompany the enlargement of such a tumor, that we have not pulled upon or injured the recurrent laryngeal nerve on the affected side. If, however, such is the case, in a short time there will be compensation in the unaffected cord and a very satisfactory voice result. In but few cases, moreover, does such an injury occur.

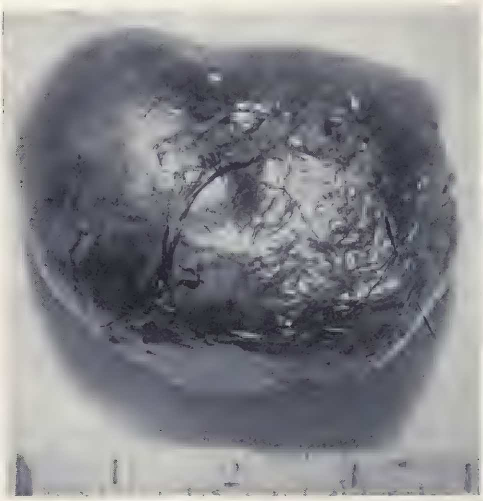


Fig. 242.—The intrathoracic adenoma—note its definite capsule; also its size, although no goiter is seen on the neck from preoperative photograph.

We are now applying the clamps to the vessels; you will observe that we are taking pains to apply them as closely as possible to the adenoma itself, so that danger of including the nerve in ligatures is lessened to the minimum. Notice that we insert a gauze strip wrung out in hot salt solution into the cavity, first, to prevent any such sudden strain on the now unsupported pleura as might come with sudden violent coughing, and, second, to control any possible oozing while the blood-supply to the goiter is being ligated.

The blood-supply is now entirely tied off, and we remove the pack from the cavity in the chest. Those of you who are close at hand may now see the extent of the cavity within the chest, and the deviation and flattening of the trachea on one side.

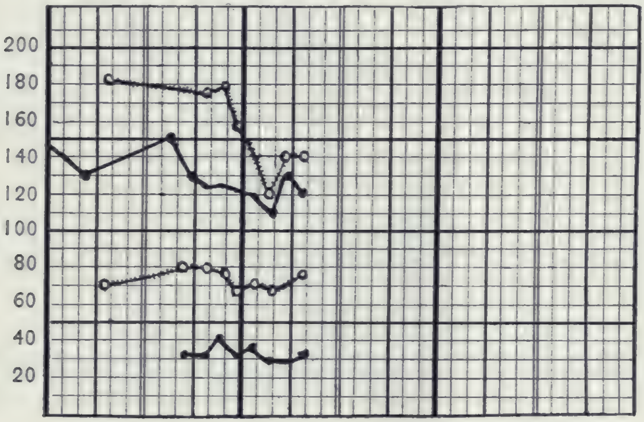


Fig. 243.—Pulse, blood-pressure, and respiration chart made by the anesthetist during removal of the intrathoracic goiter. The wavy lines indicate blood-pressure; the solid black lines, pulse and respiration. Note the moderate pulse-rate as to be presumed from the previous operative trial.

We insert a piece of rubber-dam into this cavity, as we wish to keep it drained until it has contracted and obliterated, particularly to obviate the danger of infection and consequent mediastinitis.

We suture the neck muscles with mattress sutures to include the longitudinal veins upon them, sew the platysma with 0 plain catgut, and unite the skin with horse-hair (Fig. 242).

Dr. Sise reports the man in excellent condition; he will remove the gas so that after the dressing is applied we may speak to the patient and make sure that his recurrent laryngeals are intact (Fig. 243).

Patient answers questions as to how he feels in a voice of fair tone.

January 12, 1921.

Student reporting:

The patient spoke before leaving amphitheater, showing that the recurrent laryngeal nerve was uninjured.

January 6th: Is better; has some cough in daytime. Voice: no "vim," slight hoarseness, voice deeper, can talk freely. No trouble in swallowing. Tremor unchanged. Has very little appetite. Feels good. Pulse 100 to 112. Temperature 99.3° to 100° F. Respirations 22 to 28. Sweating decreased. Appearance good. Has sense of relief from tumor tension.

January 7th: Slight tremor. Cough better. Appetite better. Eats solid food. Temperature 99.6° F. Pulse 112. Respirations 22.

January 10th: Drainage-tube removed in morning. Feels good, but is a little light-headed from $\frac{1}{4}$ grain codein given every four hours. Tremor slightly less. Exophthalmos less. Sleeps well. Appetite good. Cough better. Temperature 99.2° F. Pulse 92. Respirations 26.

January 21, 1921.

Student reporting:

Wound kept him awake a good deal. Temperature 101.6° F. Pulse 102. Respirations 28. Drain removed two days ago. Cough is better. Head feels heavy. Tremor less. Exophthalmos less. Looks well.

Dr. Lahey: I am afraid you cannot see in this *x*-ray (Fig. 244), at your distance, the course of his trachea now. If you remember, the trachea in the other picture was well over to the side. His trachea has returned almost to the middle line, and you see that the caliber of the trachea has increased at the

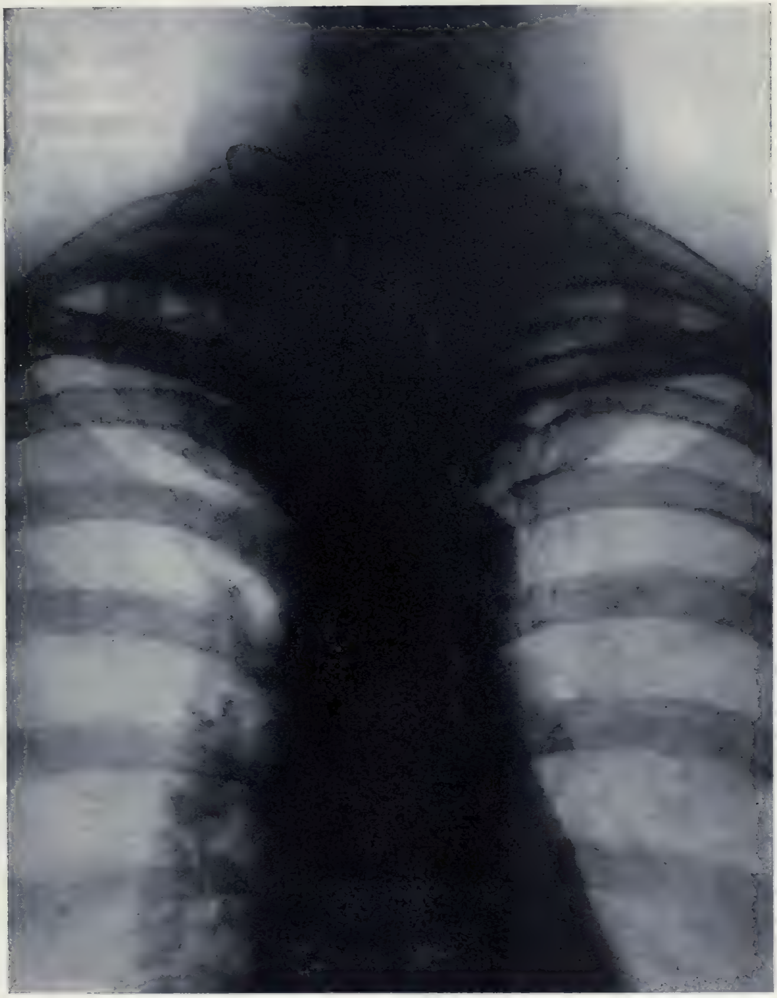


Fig. 244.—This illustration does not bring out the tracheal shadow well on account of the denseness of the as yet not entirely organized cavity left by the removal of the intrathoracic mass. Note the disappearance of the shadow of the adenoma within the chest, and that the trachea has returned sufficiently toward the midline to be within the midline shadow.

position where it was pressed upon by the intrathoracic mass. Now what is the cause of his temperature rise? Lack of drainage, undoubtedly. When the drain was removed no drain was put back into the cavity in the chest. A drain will be reinserted at once, and I am sure that this will take care of the temperature and reaction. He will leave the hospital in a few days.

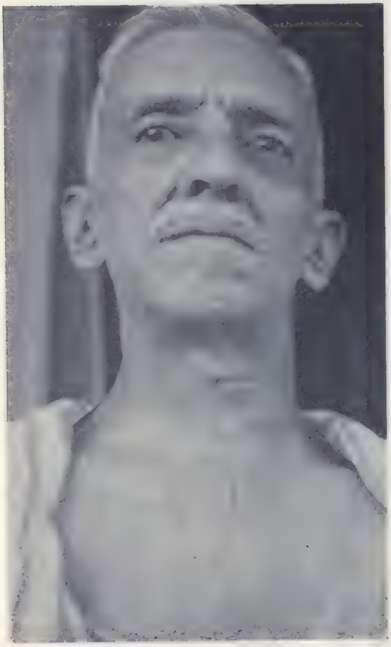


Fig. 245.—Photograph of Mr. P. taken a few days previous to operation. Note the absence of any visible goiter upon the neck.

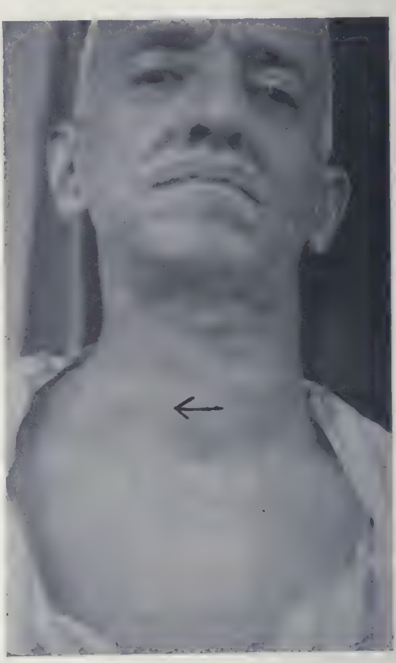


Fig. 246.—Photograph of Mr. P. voluntarily elevating intrathoracic mass partly out of the chest. Arrow points to the mass.

February 16, 1921.

Dr. Lahey: Mr. P. weighs $124\frac{1}{4}$ pounds now (Fig. 247). He says that while he was in the hospital and they were doing the metabolism test he weighed $116\frac{1}{2}$ pounds. Have you any trouble with your voice? He says that immediately after the operation he had considerable difficulty in talking, and complained of this hoarseness as if he had a cold. This is typical of these intrathoracic cases; it is clearing up rapidly, and he can talk now without difficulty, although his voice is still a

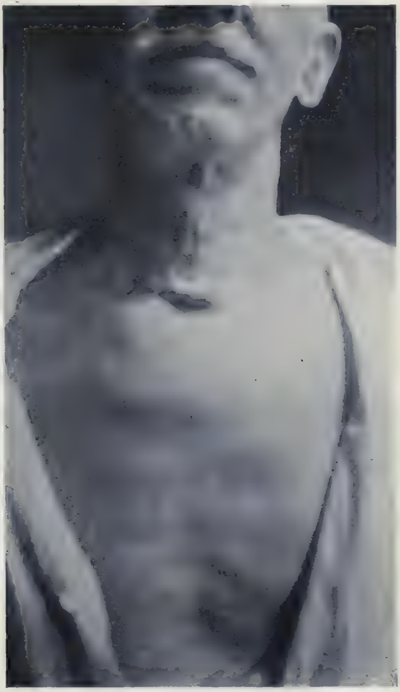
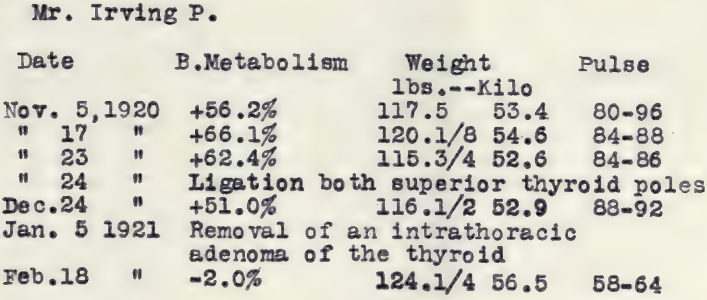


Fig. 247.—Photograph of Mr. P. two weeks postoperative. Note sinus leading to cavity in chest.



Mr. Irving P.

Date	B.Metabolism	Weight		Pulse
		lbs.--	Kilo	
Nov. 5,1920	+56.2%	117.5	53.4	80-96
" 17 "	+66.1%	120.1/8	54.6	84-88
" 23 "	+62.4%	115.3/4	52.6	84-86
" 24 "	Ligation both superior thyroid poles			
Dec.24 "	+51.0%	116.1/2	52.9	88-92
Jan. 5 1921	Removal of an intrathoracic adenoma of the thyroid			
Feb.18 "	-2.0%	124.1/4	56.5	58-64

Fig. 248.—Showing metabolism rate, body weight, and pulse-rate before ligation of superior thyroid poles, after ligation and after removal of the intrathoracic adenoma. Note the relief from secondary hyperthyroidism by removal only of an adenoma, as evidenced by return of basal metabolism rate to normal, gain in weight, and drop in pulse-rate.

little bit hoarse. His wound is healed except for a very small granulating area which ought to heal in a very short time, and he is feeling well. He says he is a new man in every way.

February 23, 1921.

Mr. P.'s metabolism preoperatively was plus 66; now it is minus 2, so you see he has been relieved of his intrathoracic goiter and also of his secondary hyperthyroidism (Fig. 248).

FROM THE ORTHOPEDIC DEPARTMENT OF THE MASSACHUSETTS GENERAL HOSPITAL

Tuberculosis of the Knee-Joint. Angioma of the Knee-joint.

By Robert B. Osgood, M. D.

Unexpected End-results Following Treatment of Congenital Dislocation of the Hip

By Zabdiel B. Adams, M. D.

Traumatic Osteitis of the Wrist

By Mark H. Rogers, M. D.

Tuberculosis of the Sacro-iliac Joint

By M. N. Smith-Petersen, M. D.

The Syme Amputation

By Philip D. Wilson, M. D.

Spastic Paralysis. Neurotomy (Stoffel Operation) as a Method of Treatment

By Rafe N. Hatt, M. D.

CLINIC OF DR. ROBERT B. OSGOOD

Massachusetts General Hospital

TUBERCULOSIS OF THE KNEE-JOINT. ANGIOMA OF THE KNEE-JOINT

TUBERCULOSIS OF THE KNEE-JOINT

In presenting 3 cases of tuberculosis of the knee-joint in adults we shall give brief case histories first, followed by summaries. We shall then make a statement of belief in regard to the treatment of this serious condition. The basis of this belief is fifteen years' experience in the Orthopedic Clinic of the Massachusetts General Hospital.

Case I.—The first case represents a failure in treatment, due very possibly to technic, which we recognize to have been faulty. It is fair to say, however, that the case represents one type which we have occasionally encountered in which resistance to the infection is very low and the character of the disease, at least locally, is almost malignant.

J. A. Age twenty-one. Single. No occupation. Entered the Massachusetts General Hospital in May, 1920. Family history negative. Past history negative except for children's diseases.

Present Illness.—Six years ago, while in school, the left knee began to feel "funny" in running. There was very little pain and no acute onset. Gradually a swelling was noticed and limitation of motion. Seeking local medical advice, the knee was strapped by his family doctor. In spite of various forms of treatment, and although there have been numerous periods of betterment, the knee remained swollen, became more limited in motion, until five months ago, when all motion was lost. The swelling became tense, the pain more acute, and a loss of weight began.

In the spring of 1920 he came to the Peter Bent Brigham Hospital, and we were asked to see the case in consultation by Dr. John Homans, who had recognized the true nature of the disease and confirmed it by roentgenologic examination (Fig. 249).

The young man was thin, pale, and had the facies of pain and anxiety. The knee, which had not been immobilized until Dr. Homans had seen him, was tense, tender, hot, but not reddened, and was extremely painful to the slightest jar. All motion was guarded by strong muscle spasm. The body temperature did not go above 100° F. and the general examination was negative. It seemed in a most unfavorable state for operative interference other than amputation. He had a good home in the country, and recumbency in a well-fitting cast, with heliotherapy and an antituberculous régime, was advised for a month.

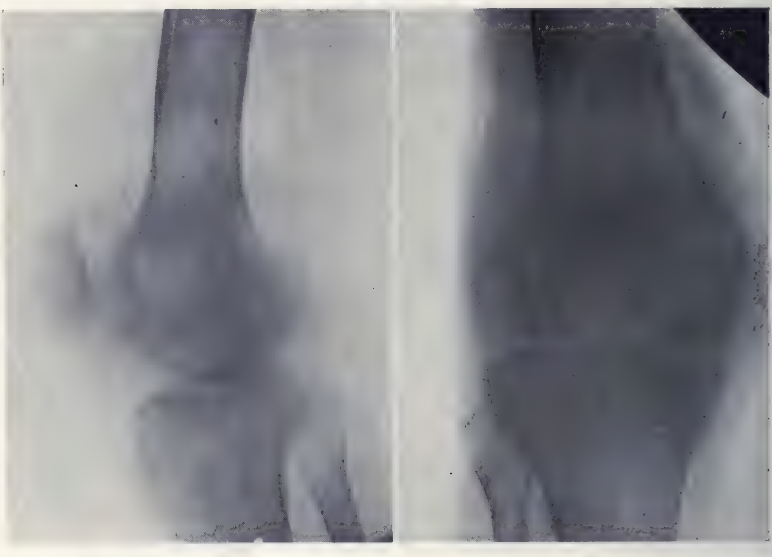


Fig. 249.—Case I. Lateral and ant. post. roentgenograms. Before operation. Hazy and irregular articular surfaces. Loss of substance on lateral condyle.

In spite of this treatment, apparently well carried out, he entered the Orthopedic Service of the Massachusetts General Hospital on May 28, 1920 in somewhat better general condition and with a normal temperature, but with the knee still tensely swollen and firmly fixed by muscle spasm.

With the hope of rendering the local conditions less acute and more favorable for operation, the knee was aspirated to relieve the tension, and translucent, straw-colored fluid was withdrawn. This fluid was injected into a guinea-pig and proved later positive for tuberculosis. After three weeks of further recumbency the fluid returned, though the knee was a little less sensitive, and operation was decided upon.

At this time the general examination was negative. No lung involvement could be detected. The urine was normal and the Wassermann test negative.

On May 6, 1920 the operation of excision of the knee was performed under ether anesthesia. A tourniquet was applied to the thigh. A quick excision was performed through a U-shaped incision, crossing and dividing the patellar tendon, turning back the flap, dissecting out very hastily the mass of tuberculous tissue and pannus filling the cavity. Much free fluid and masses of fibrin escaped. The eroded under surface of the patella was removed with a saw, and thin slices of the femoral condyles and the head of the tibia were also resected with a flat saw. The angles had been previously calculated by a tracing of the roentgenogram and 15 degrees of flexion were provided. A flat, fresh bone surface on the anterior surface of the femoral condyles was prepared to receive the freshened inferior surface of the patella. Two boiled beef bone-pegs were driven through the femoral condyles into the tibia, one from the lateral and one from the mesial side. It was later shown by the Roentgen plate (Fig. 250) that these were not of sufficient length to obtain a firm hold. The excised knee seeming stable, with raw bone surfaces in apposition, the tourniquet was removed, the bleeding, other than the ooze from the bone, was controlled with plain catgut ligatures, the patellar tendon was reunited, and the wound closed, without drainage, with silkworm gut. This was a departure from our usual custom of inserting in the upper corners of the incision small rubber tissue drains to be removed in forty-eight hours. The reason for this departure was that the bleeding seemed well controlled, and we wished in this case to avoid all possibility of secondary infection, recognizing the gravity of the case. A sterilized metal ham splint, bent to 15 degrees, was placed over the dressing, held by an assistant, and a plaster spica bandage applied. Time of operation, fifty-seven minutes.

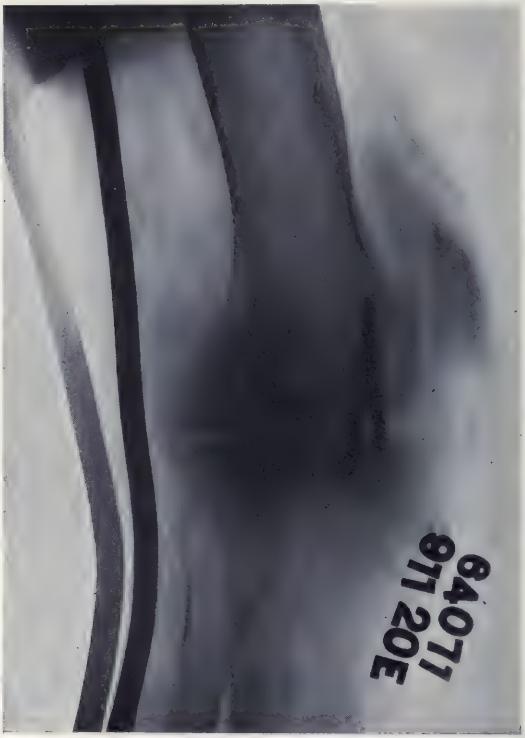


Fig. 250.—Lateral roentgenogram of Case I. After excision. Bone-pegs inefficiently placed.

The patient bore the operation only fairly well. There was a febrile reaction reaching 102° F., pulse 106, on the second day, but returning to normal on the sixth day.

The stitches were removed on the fourteenth day and considerable serosanguineous fluid and "gelatinous" material was expressed. The skin in many places gave little evidence of tendency to unite. This discharge persisted, with a normal temperature and no local reaction, under complete immobility and treatment with the sun's rays.

He was discharged to the Out-patient Department six weeks from the date of the operation, in fair general condition, with no pain or temperature, with the wound still weeping and not entirely, but almost entirely, healed. He was immobilized in an ankle-to-groin plaster and crutches without weight bearing. An ample window in the plaster allowed free access to the dressing. At the time of application of this second plaster the patella was not fixed and there was motion between the bone ends. He returned to his home under the care of his local physician, but returned to the Out-patient Department one month later for observation. He was having no pain, but the knee was more swollen and there were many sinuses of a characteristic tuberculous appearance. There was no union.

He was readmitted in August, about nine weeks after the operation. The Roentgen plates showed that the beef bone-pegs, which had been driven only a short distance into the tibia, had not held, and there was a space evident between the bone ends. A special open wire splint, providing traction to force the bone ends together, was applied, but in spite of alternate pressure bandages and heliotherapy the wound gradually broke down and tuberculous granulation tissue presented.

More perfect immobilization, furnished by a plaster cast with windows, relieved his pain, and a Roentgen plate showed that a better apposition of bone ends had been secured by the special traction splint. However, the temperature became irregular, reaching 102° F. at night. There was no local inflammatory reaction. His general condition seemed to be growing steadily less good and his resistance lessening, and on September 24th, a little over three months after the operation, an amputation was performed by Dr. Philip Wilson through the lower third of the thigh.

Two weeks later he was walking on a plaster pylon, and when last seen, a month after the amputation, he was in much better general condition, with a healed stump, and walking well on his pylon. A personal communication (May 15, 1921) states that the stump remains healed, he has gained in weight, no other joints are troubling him, and he feels generally well.

Summary.—The case illustrates a fortunately rare, but an occasionally encountered type of tuberculosis of the joints, in which the resistance to the invading organism, both local and general, seems very low. In the clinic we have had one other case in which no fault of technic entered as it did in this case, but in which the course of the disease was unchecked by a radical resection, a thorough subsequent reopening of the wound, and Dakin-Carrel treatment. Amputation after an even longer interval alone checked the disease.

Both cases were in men not weakened by other disease and with good early histories, but presenting an almost cachectic appearance when they sought our advice.

We recognize as probable mistakes in judgment in this case, first, the endeavor to do too quick an operation, which resulted in our failure to remove thoroughly the gross pathologic tissue, and in an imperfect internal fixation of the femur and tibia. We believe that the time spent in the removal of this pathologic tissue in a case like this is well spent. At least there would be less left for nature to remove when natural reparative processes, as in this case, were at a very low ebb. We believe also it was bad judgment not to insert temporary rubber tissue drains. Much fluid and some hematoma escaped when the stitches were removed. It is possible also that too little bone was removed. Tempted by reports of successes from what are scarcely more than erasions, without removal of tuberculous tissue, only thin slices were sawed off the femur and tibia, and although on the cut surfaces no gross appearance of tuberculous bone disease was seen, there may well have been cavities proximally and distally. It is quite possible also that secondary infection played some part, though we were never able to prove it culturally or otherwise, but it is hard to prevent in the presence of sinuses which were present from the day the stitches were removed. We also believe that firm internal fixation, not secured in this case, promotes early union and greatly diminishes postoperative pain.

Granting poor judgment and recognizing faulty technic, we still believe that there are cases of this severe type of tuberculosis of the knee which become rather rapidly fulminating after a long history (in this case six years) of a mild course, in which even thorough well-performed operations of resection fail to check the progress of the disease. In these cases our prognosis should recognize the possibility of amputation.

Case II.—The second case is that of a young woman, C. B., twenty-one years of age, single, a novitiate in a convent, who came to the Out-patient Department of the clinic in October, 1911, complaining of pain and swelling in the left knee, of eighteen months' duration, and gradual onset without known history of trauma. Lately much kneeling had made the knee worse. The family history was negative. The past history was negative except for typhoid fever eight years previously.

The physical examination was negative except for slight general swelling of the left knee, tenderness over the area of swelling, and slight surface temperature. There was no free fluid, but limitation of flexion at about 110 degrees. The Wassermann reaction was not taken at this time, but later proved negative. The roentgenologic examination revealed no bony lesion. She was admitted to the hospital with the diagnosis of tuberculosis of the knee.

A subcutaneous injection of 1 mg. of Koch's old tuberculin gave a positive general and local reaction.

At this time we held strongly to the theory that tuberculosis of the joints might be sometimes primary in the synovia, arguing from the apparent primary infection of other serous membranes. Stimulated by the hope of arresting the process, if it were confined to the synovial membrane, by some local application of an antiseptic, Dr. E. G. Brackett opened the joint, found a tuberculous pannus, but no demonstrable articular cartilage lesion, and, closing the joint tight about a syringe nozzle, injected a 4 per cent. solution of iodoform in pure bland olive oil until the capsule was slightly distended. By means of a double loop stitch around the syringe nozzle the synovia was drawn together and stitched so that no oil escaped. It was hoped that the bactericidal properties of the iodoform oil would be enhanced by confining it in an air-tight cavity, and that its oily vehicle would perhaps increase its penetration and inhibit adhesions. The lateral expansion and skin were tightly closed and a plaster cast applied. The convalescence was uneventful. She was seen from time to time in the Out-patient Department, wearing a bivalved plaster cast, which was removed daily for voluntary motion. The knee remained somewhat swollen, but was free from tenderness until December 30, 1912, when she was readmitted, fourteen months after the operation, because of increased swelling and tenderness over the whole synovial sac.

At this time the patella was slightly movable, there were 10 degrees of permanent flexion and 30 degrees of motion in flexion. The Roentgen plates still showed no involvement of the bones.

On January 2, 1913 a second arthrotomy was performed by Dr. Brackett. The capsule was found greatly thickened and adherent, and from one of the pockets about 1 c.c. of oil escaped, injected fourteen months previously. It was hard to determine the exact limits of the joint cavity, which was filled with pannus. Adhesions were gently divided and the cavity again filled with 4 per cent. iodoform oil and closed tight.

The immediate convalescence was uneventful and the patient was discharged in a bivalved plaster with 5 degrees of motion. She reported from time to time in the Out-patient Department, and motion increased to 30 degrees of flexion. A light caliper knee brace was applied, allowing 25 degrees of motion in the knee, and in August, 1917, four and one-half years after the second iodoform oil injection, she was in good general condition, able to do light housework, and considered herself a little better than before operation. She was wearing the brace and used neither crutch nor cane, but at times the knee was painful. It was thought that the disease had been arrested.

On October 30, 1920 she reported again because of a return of more acute symptoms in the knee. The brace had been broken for several weeks and she had been bearing her weight without its protection. The local examination showed general capsular thickening, but no free fluid. The patella was slightly movable. There was no local heat and only slight tenderness. There was no muscle spasm and slightly increased lateral and antero-posterior mobility, 5 degrees of permanent flexion, 30 degrees of motion in flexion without pain, and 40 degrees with pain. There was only 2.5 cm. atrophy of the thigh and 1.25 cm. atrophy of the calf. The Roentgen plates showed much increased density of the soft parts and well-marked involvement of articular surfaces (Fig. 251). She was sent into the hospital, and under ether anesthesia, on November 3, 1920, an excision of the knee by the technic described above, but with more careful dissection of pathologic tissue, was performed, decussating bone-pegs

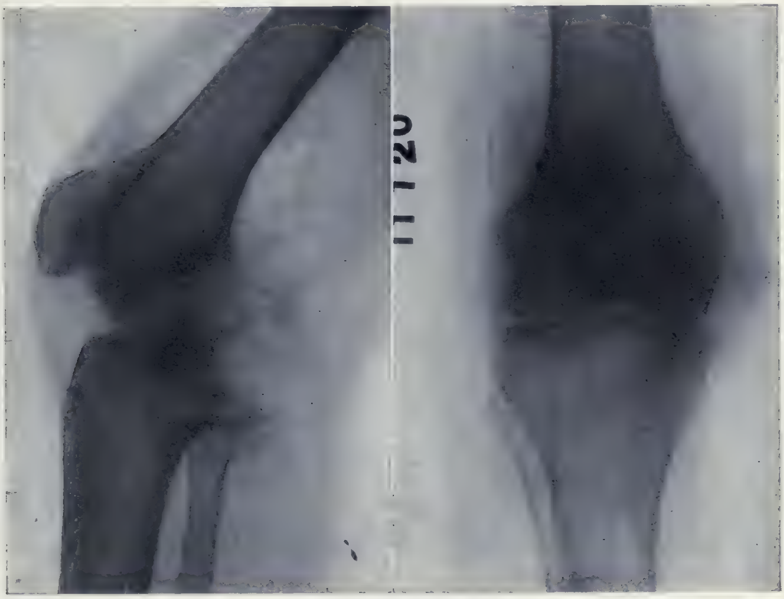


Fig. 251.—Lateral and ant. post. roentgenograms of Case II before operation of excision.

being employed as a method of internal fixation and rubber tissue drains inserted for forty-eight hours. The knee was put up in plaster in 30 degrees of flexion. The pathologic report by Dr. Hartwell was as follows: Thin section of the articular surface of the knee-joint. There is considerable erosion of the articular cartilage. Microscopic examination of a section of one of these thin pieces shows fibrous thickening of the synovia with necrosis and an occasional small focal collection of epithelioid cells. There is proliferation of bone and fibrosis of marrow. Tuberculosis.

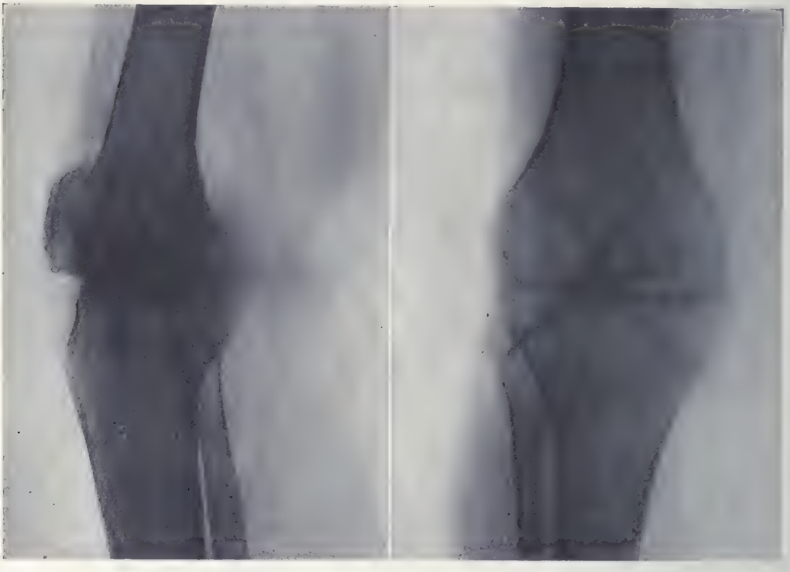


Fig. 252.—Lateral and ant. post. roentgenograms of Case II after operation of excision.

There was no febrile reaction and almost no pain following the operation. A new plaster bandage from toes to groin was applied in four weeks without pain, and the knee felt firm. Union was apparently solid in eight weeks and weight bearing begun in twelve weeks. She was last seen on May 9, 1921, when there was free use of the knee without protection and solid union (Fig. 252).

Summary.—The case is instructive because of the gradual onset of symptoms, much like Case I, coming on at the same age, but subjected to conservative treatment soon after the onset. In spite of more or less continuous immobilization and two injections of iodoform oil in the absence of demonstrable bony foci, the disease continued, though apparently arrested, for over four years, during which she was leading a fairly active life. This again illustrates, though in a somewhat different way, what may be called the local malignancy of adult knee-joint tuberculosis.

Case III.—The third and last case to which we shall direct your attention is interesting because, though clinically and to gross pathologic examination it presented all the symptoms of tuberculosis, the microscopic examination of the tissue removed revealed no evidence of tuberculous involvement, and the roentgenogram was not entirely characteristic, suggesting lues. Even lacking this evidence, we still believe the case to be one of tuberculosis, perhaps of the caries sicca type.

H. J. S. Single. A stable worker. Came to the Out-patient Department on December 8, 1920, complaining of pain, swelling, and stiffness of the right knee. His family history was negative. His past history included the usual children's diseases and a Neisser infection twenty years previously, without known sequelæ. Seven years ago, because of a chronic cough and loss of weight, he consulted his local physician, and a diagnosis of tuberculosis of the upper lobe of the left lung was made. He was in a sanatorium for two years and five months, being discharged as cured, although his knee, which had begun to trouble him in 1912, the year previous to his entrance, continued to be swollen and somewhat painful.

His present illness dates from 1912, seven years before he was seen in the Out-patient Department of the Massachusetts General Hospital. In his occupation as a stable worker he frequently struck his knees on the wheels of carriages, and noticed a persistent soreness of gradual onset on his right. This soreness and swelling persisted while he was in the sanatorium and continued when he resumed his former work after his discharge. The swelling slowly increased and the motion slowly decreased, until six months ago, eight years after the onset, he found he could not ride in short stirrup. He still continued to work, however, until about two weeks before coming under our observation. He had been obliged to stand more than usual, the pain became more acute, no motion was possible, and he could not walk without the use of crutches. Pulmonary examination revealed harsh breathing sounds in the left axilla and an occasional "whine," followed by crepitant râles for a few breaths. The general examination was otherwise negative. The right knee was held rigidly in 45 degrees of flexion. There was slight general swelling, but no free fluid. No redness or tenderness, and slight local heat. The patella was not movable. There was 25 cm. atrophy of the right calf, 5 cm. atrophy of the thigh. The Roentgen plates (Fig. 253) showed rather extensive destruction of the joint surfaces and a narrowing of the joint

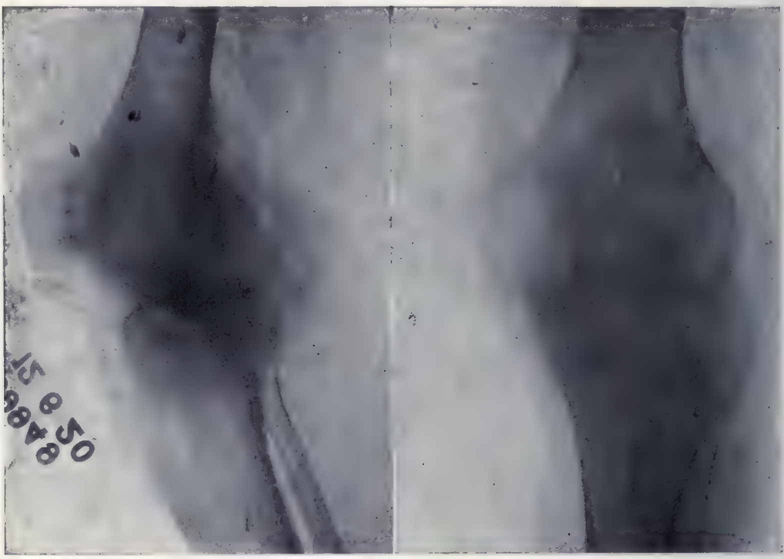


Fig. 253.—Lateral and ant. post. roentgenograms of Case III before operation. Note small punched-out area at mesial border of head of tibia, seen frequently in lues.

space, very little structural bone atrophy, almost no proliferative bone changes, but considerable soft-part thickening. There was a small punched-out notch on the mesial corner of the articulating surface of the tibia and a little lime salt deposit on the lateral aspect of the shaft of the femur about 12 cm. above the joint, which suggested lues.

A light plaster case was applied and he was recommended for admission to the hospital, with the diagnosis of tuberculosis of the knee for excision. Both the blood and spinal fluid gave a negative Wassermann test. No subcutaneous tuberculin injections were given because of the possible lung process.

On December 23, 1920, under spinal anesthesia, the knee-joint was excised by Dr. Charles Peabody, then the Senior Orthopedic Intern. Decussating pegs of boiled beef bone were employed as a means of internal fixation, after removal of the articulating surfaces. There was a careful dissection of the gross pathologic tissue, which was quite characteristic of tuberculosis. Rubber tissue drains were inserted for forty-eight hours. The knee was fixed in 30 degrees of flexion because of his occupation as a driver and rider.

The pathologic report from Dr. H. S. Hartwell was as follows: Thin sections of the articular ends of the tibia and femur with irregular pieces of soft tissue. The cartilaginous surfaces of both bones show numerous erosions. Microscopic examination of a section made from the soft parts shows vascular granulation tissue and fibrosis. There is no evidence of tuberculosis. Chronic inflammation.

The convalescence was uneventful. The wound healed by first intention. The plaster was changed in four weeks and the knee felt firm. He was discharged to the Out-patient Department. In eight weeks union was apparently firm, and weight bearing was begun in twelve weeks (Fig. 254). It will be noted that the boiled beef bone-pegs had already begun to be absorbed.

He was last seen on May 6, 1921, a little over four months after operation. Union was firm and he had resumed his work. Flexion remained at 30 degrees.

Summary.—The case is interesting because of the negative pathologic report and the positive lung findings. The history is fairly typical of low-grade tuberculosis of the knee of long duration. The roentgenologic examination and the gross appearance of the tissue at operation seem stronger evidence still. It is hard to conceive of any chronic inflammatory process running such a course, and lues is improbable with a negative history and a negative blood and spinal fluid Wassermann. Again, we have a long history and an eventually incapacitating joint disease demanding eradication and the operative accomplishment of complete bony ankylosis, which nature unaided seems unable to bring about.

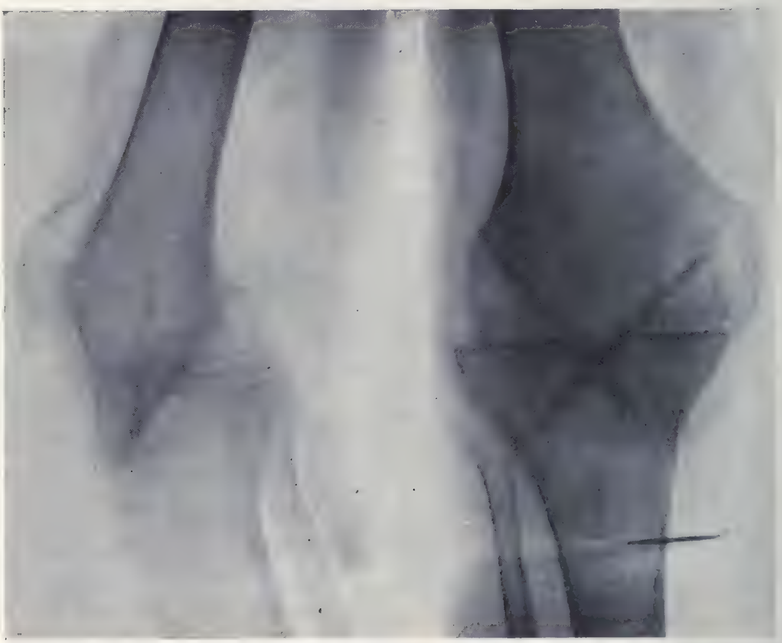


Fig. 254.—Lateral and ant. post. roentgenograms of Case III twelve weeks after operation of excision.

Comment.—These 3 cases seem to furnish illustration for certain beliefs which we have come to hold regarding the incidence, course, and treatment of tuberculosis of the knee-joint in adults.

1. The onset may be very insidious, and trauma may or may not seem to play an important part. In the first 2 cases no history of significant trauma could be elicited.

2. The early examination and the course of the disease may be very deceptive, leading even experienced surgeons to make incorrect diagnoses and prescribe inefficient treatment. Although frequent almost complete remissions occur, and pain and disability disappear, we believe physical signs of disease are never completely absent, and the persistence of a gradually increasing disability is the unbroken rule. The course of mild symptoms may extend over many years, but without treatment resistence to the disease may rather suddenly break down, as in the first case, and the prognosis as to eradicating the disease by a less radical operation than amputation then becomes doubtful.

3. *Treatment.*—We believe that as soon as the diagnosis is positively made operation should be advised. If the joint is in an acute state of irritation from lack of supportive treatment, we consider it wise to insist on a period of perhaps a month, during which recumbency, complete fixation of the joint, and general heliotherapy should be enforced.

Operation.—Notwithstanding a number of early encouraging results in mild cases in which no bony involvement could be demonstrated, we consider that arthrotomies and bactericidal injections are so generally inefficient in controlling the disease as to represent a waste of time, if not an actually dangerous delay, in eradicating the disease. This is well illustrated in Case II and in many others we have had the opportunity of following.

We believe that as soon as the diagnosis has been positively made and the joint irritation from lack of protection has been quieted down, a radical excision of the joint should be performed by a U-shaped incision, with as careful a removal of gross pathologic tissue as can be accomplished. The method of Sir Harold Stiles of dissection of the whole quadriceps pouch and patella has much to recommend it. The amount of bone to be removed depends upon the extent of the bony involvement, varying from an erasion to the removal of considerable portions of the articulating surfaces and the cureting of bony cavities.

The amount of desirable flexion should be determined beforehand by a consideration of the social status of the patient. In a woman less than 30 degrees of permanent flexion is rarely desirable. In a man we believe at least 10 degrees will provide a more useful limb for walking, standing, and sitting than less. In adults, after firm union has occurred, we have not found this permanent flexion to increase with function. It is extremely helpful to calculate the angles of the saw cuts necessary to secure these degrees of flexion before the operation by cutting a paper pattern of an accurate lateral roentgenogram and performing a paper excision.

We believe that some form of internal fixation is to be strongly advised. Ely's experiments in resecting the knee-joints of dogs have demonstrated the fact that without most perfect subsequent immobilization following the resection there is almost no tendency to bony union, since callus does not form about articular bone ends. This internal fixation may be furnished by mortising the bone ends. This lengthens the operative procedure considerably and is rarely firm. The same objection holds in regard to autogenous bone-grafts. Kangaroo tendon in a bundle knot (Osgood and Bull, Jour. Amer. Med. Assoc., October 6, 1917) is quick and fairly efficient. Metal plates and wire nails must be removed later.

We are impressed with the efficiency of decussating boiled beef bone-pegs driven through smaller drill holes from the tibial condyles into the femoral condyles, while the flat bone surfaces are accurately apposed by assistants. We have never known these boiled beef bone-pegs to cause irritation or act as sequestra (10 cases). They are usually gradually absorbed after their usefulness is over. Small rubber tissue drains in the upper corners of the wound provide for the inevitable ooze for forty-eight hours. A thin sterile sheet metal ham splint (Brackett) greatly aids the assistants in holding the limb firm while the plaster is being applied. In stout subjects the first plaster should be a spica including the foot. We expect little pain following an operation thus performed, which should be completed in an hour. There is frequently a rise of temperature for several days, representing, we believe, a tuberculin reaction as the result of the operation. The patient should be recumbent for four weeks. The plaster should then be changed, and the case discharged to remain mostly recumbent for another four weeks, at the end of which time, if union seems fairly firm, crutches are allowed and weight bearing in a bivalved ankle-to-groin plaster is encouraged at the end of twelve weeks. The plaster is removed at night and gradually omitted if union is firm.

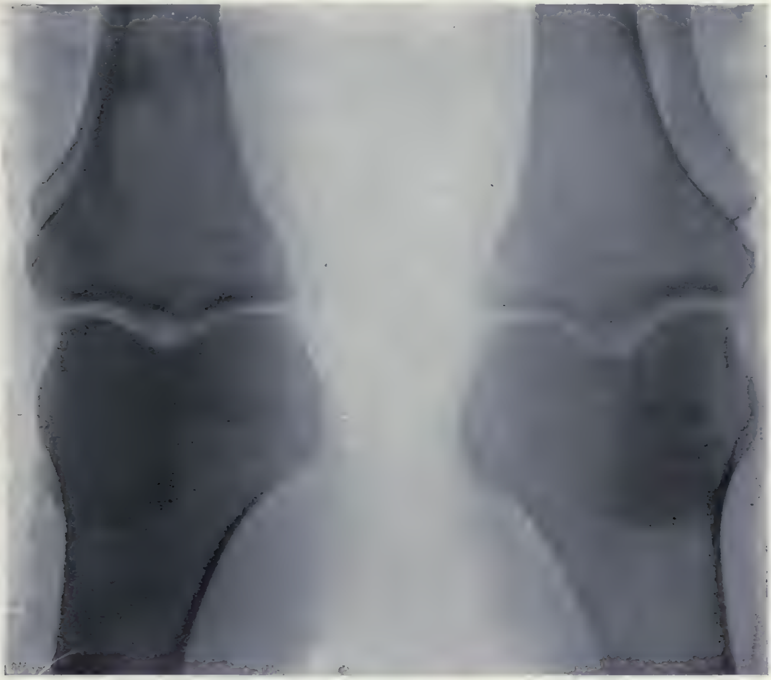
ANGIOMA OF THE KNEE-JOINT

After a somewhat cursory review of the literature of joint tumors we have found but 3 cases of angioma of the knee-joint reported.

On March 15, 1921 a case of supposed internal derangement of the left knee-joint in a young married woman of twenty-six was referred to the writer. The subject was a slender, healthy looking woman, complaining of rather intermittent symptoms in the knee, of eight years' duration. The family history was negative. The past history was negative except for the usual children's diseases and the presence, as long as she could remember, of a peculiar, rather profuse growth of straight hair about 8 cm. in diameter over the last lumbar vertebra and upper portion of the sacrum. She had had a somewhat weak back for many years and some discomfort after lying directly on the back, but no severe pain and no nerve root or cord pressure symptoms. After finishing school she had been employed as a stenographer until her marriage five years previous to being seen. There had been one healthy male child, age three years.

Her present illness dated back eight years, and followed a definite injury caused by hitting the mesial aspect of her knee a sharp blow against a filing cabinet. Pain and swelling followed and the knee could not be completely extended. A physician was consulted two days later, and gradual subsidence of symptoms occurred after a prolonged convalescence of thirteen weeks. She could now walk and dance without discomfort, and motion was almost normal, though slight swelling persisted. Two years later (six years ago) in stepping down from a chair a sudden "slip" in the knee, referred to the inner side, occurred, and swelling and disability ensued for six weeks, followed by complete recovery of function, though a slight swelling persisted. Two years later (four years ago) a similar slip occurred while the patient was reaching to pull down a curtain. A similar convalescence followed. In November, 1920, four months ago, while cleaning house, a sudden disability of the knee occurred without the sensation of a definite slip or catch, but with pain referred to the inner side of the joint and with subsequent swelling. After immobilization in a plaster cast for six weeks the symptoms disappeared and painless function has been possible since.

The general examination was negative except for the patch of hypertrichosis above referred to. Palpation of the lumbar spine revealed an absence of the last two lumbar and first two sacral spinous processes and an apparent spina bifida confirmed by roentgenograms without any meningocele and with only slightly disagreeable sensations to pressure over this area. The examination of all the joints except the left knee showed normal contours and motions. The left knee was slightly limited in extreme flexion and could not be hyperextended. There was 2.5 cm. atrophy of the left calf and 1.5 cm. atrophy of the left thigh. The left knee measured 1 cm. more than the right below the patella, 2.5 cm. more over the patella and above the patella. There was no free fluid in the joint and the change in contour was apparently caused by a slightly movable mass, most easily palpable below and to the mesial side of the patella, but extending beneath the patellar tendon and indefinitely palpable on the lateral aspect of the joint. This mass was slightly tender to pressure, as was the mesial joint line. The joint was slightly relaxed, showing a little lateral hypermobility. There was no deformity of the weight-bearing line. The roentgenogram (Fig. 255) showed slight general atrophy of structure of the bones and increased radiability on the left, but no irregularity of the articular surfaces except at the spine of the tibia, and no focus of disease. The shadow of the mass in the joint was evident (Fig. 256). The Wassermann reaction was negative. The diagnosis of a tumor of the knee-joint and a possible hypermobility of the internal semilunar cartilage was made. Surmises as to the nature of the mass were recorded in the following order: 1. A lipoma arborescens; etiology, trauma. 2. A tumor of unknown origin and nature. 3. A tuberculous pannus. 4. A solitary gumma.



Case 255.—Ant. post. roentgenogram of both knees of Case IV, showing increased radiability of bones on left of plate, representing left knee of case.

Exploratory arthrotomy, with removal of the mass and a possible excision of the internal semilunar cartilage, was advised, but the consent of the patient was not immediately obtained. One month later, however, in April, the patient accepted the advice and consented to a resection of the knee, if at the time of operation a reasonably certain diagnosis of tuberculosis could be made.

After a forty-eight-hours preparation, under ether anesthesia, by an entirely instrumental technic, the following operation was performed under a thigh tourniquet: A 7-cm. incision, beginning about 2 cm. from the mesial side of the upper border of the patella and extending distally to just below the joint line, curving posteriorly 2 cm., was carried down to the synovia. Through the translucent synovia could be seen a dark mass which immediately presented upon opening the synovia, lightly adherent to it. A normal amount of clear synovial fluid escaped. The dark red surface of this mass closely resembled the lobule of a fresh chicken liver. It was covered by a thin capsule or reflection of the synovial membrane. By careful division of

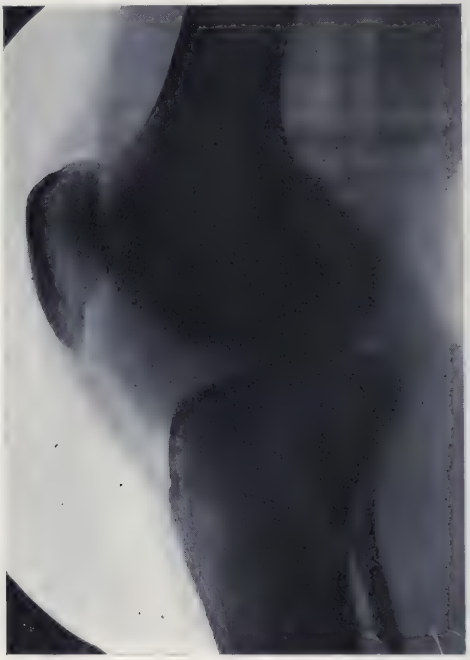


Fig. 256.—Lateral roentgenogram of Case IV. Note shadow of tumor mass beneath patellar tendon.

fine adhesions the mass was freed from the synovial membrane and found to be attached by a considerable surface or short pedicle to the infrapatellar fat pad. A lobule of the mass protruded into the intracondylar notch and was adherent to the ligamentum mucosum and to the insertion of the anterior crucial ligament. It extended laterally beneath the patellar tendon, and gentle traction gave a sensation of tug which could be appreciated by palpation on the outer side of the joint. Fearing to blindly separate the adhesions on the outer side of the joint, a 5-cm. linear incision was made on the lateral aspect of the joint and the mass discovered quite firmly adherent to the synovial membrane. By careful blunt dissection and division of the adhesions the mass was freed on the outer side up to its infrapatellar fat pad pedicle. In the same manner the lobule extending into the intercondylar notch was freed. The pedicle, including a portion of the intrapatellar pad, was last divided, and the lobulated mass, roughly 8 x 4 cm., delivered through the mesial incision. The pedicle was examined, but no vessels of large size being detected, no ligature was placed about it. Examination showed the thin investment of the mass to be intact. The internal semilunar cartilage was next inspected. There was no scar of an old or new lesion, but its hypermobility being unquestionable, it was removed almost completely. The synovia was not injected and the articular surfaces appeared normal. The synovia was now closed tight on both sides by interrupted fine black silk sutures. The lateral expansions of the quadriceps were closed in like manner, subcutaneous stitches of 00 catgut were placed, and the skin incisions closed with fine black silk. A copious compression dressing was applied and the limb not immobilized. There was very little pain following the operation, and at the end of seven days, when the stitches were removed, first intention healing had occurred. There was no joint effusion. There were 30 degrees of painless motion. The patient was allowed to be up on crutches on the tenth day, and was discharged relieved on the twelfth, allowed to bear a little weight, and with 45 degrees of painless motion. This motion has increased until at present, four weeks after the operation, there is over 90 degrees of voluntary flexion, full extension, and painless weight bearing. There is no joint effusion or swelling.

The unopened tumor mass was taken immediately following the operation to Professor S. B. Wolbach, of the Harvard Medical School, and his report follows:

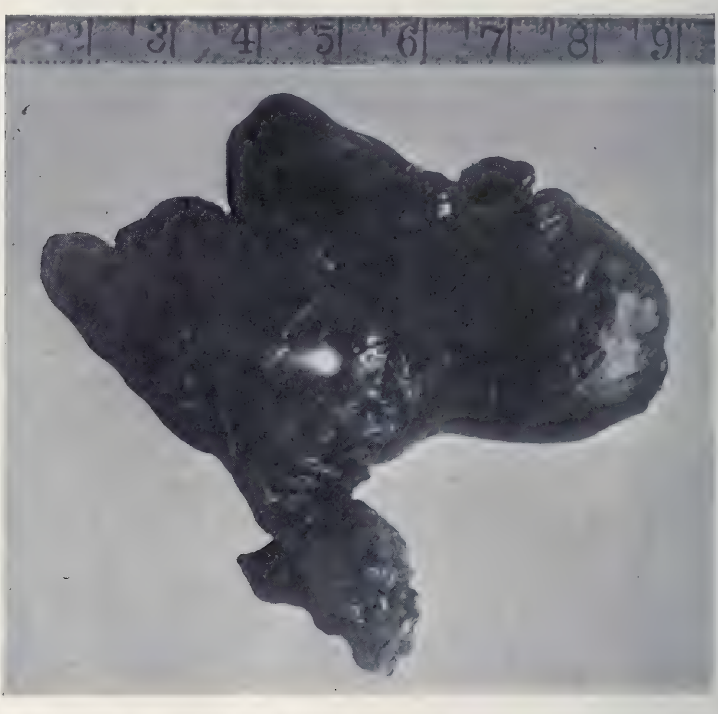


Fig. 257.—Photograph slightly enlarged (note centimeter scale) of cavernous hemangioma removed from Case IV. Pedicle attached is infrapatellar pad.

"Material from knee-joint. April 17, 1921. (Dr. Osgood.)

"Gross description: Specimen consists of a lobulated mass of tissue, somewhat resembling thyroid gland in appearance and consistence. It weighs 37 gm., is 8 cm. long, averages 1½ cm. thick and 3 to 4 cm. in width. One margin is smoothly convex and has attached to it a tab of fat tissue 2 x 1 x 0.5 cm.

The other margin is irregular in shape with at one end a somewhat flattened process with several projecting tongues. A similar tongue-like projection comes from the middle of its border. The consistence is fairly firm. The color is deep red and it is completely encapsulated. Incision reveals a loose, spongy texture with the interstices filled with blood. The consistence of the tissue as a whole is tough and fibrous, and the gross appearances are consistent with hemangioma (Fig. 257).

"Microscopic report: Sections of material taken from three different parts of the tumor are all practically of the same structure throughout. The tumor is made up of large endothelial lined spaces filled with blood and separated by compact connective tissue in which are numerous small normal appearing arteries, veins, and capillaries. One portion of the tumor shows a heavy framework to the blood-spaces, and in all three sections there are collections of lymphoid cells resembling lymph-follicles in that each is supplied by one or more small capillaries and separated by very loose textured reticular tissue. There is considerable refractive brown pigment in the form of granules in the connective tissue of the tumor as a whole. This pigment is contained within cells. There are also a few small bundles of nerve-fibers present. The endothelial lined spaces which give the tumor as a whole a sponge-like texture are of various shapes. Many of them cut longitudinally show very free anastomosis of adjacent cavities. The surface of the specimen is covered with a similar layer of flat cells. In the outermost zone of connective tissue surrounding the tumor as a whole are occasional clusters of small capillary-like blood spaces suggesting the possibility of a cell extension or increase in the size of the tumor.

"Diagnosis: Cavernous hemangioma. S. B. Wolbach, pathologist." (Fig. 258.)

Ewing[1] states that cavernous angiomata occur in many situations and may involve nearly all tissues and organs. Cruveilhier reports the case of a hemiplegic of sixty-five, in whom a cavernous angioma of the arm involved skin, muscles, tendons, synovial membrane, nerves, and periosteum. Thoma considered mechanical factors to play a part in the growth of angioma, and Virchow believed that they resulted from the action of local irritation on imperfectly formed vessels, such as those in embryonal fissures. The smaller tumors are usually encapsulated and more or less stationary, though the course of a cavernous angioma is slowly progressive, and they may attain large dimensions. They commonly first appear as a circumscribed tumor developing upon the basis of a congenital nevus. Their texture is roughly that of a sponge.

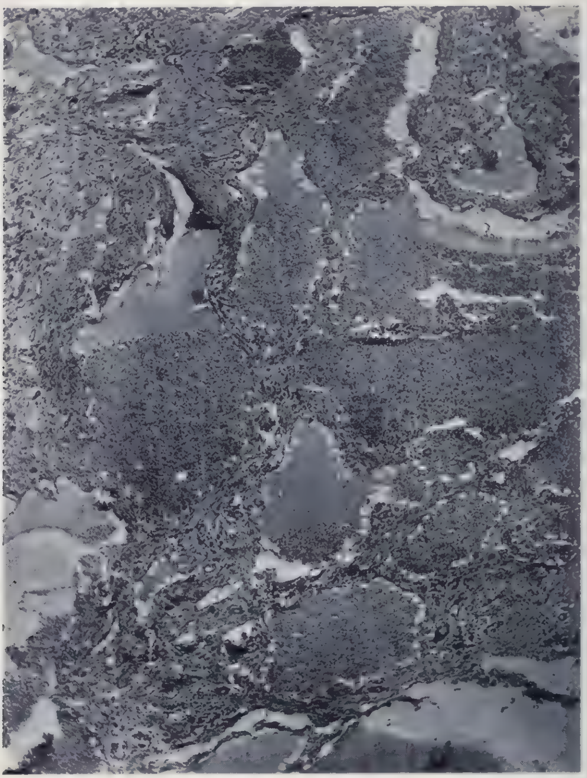


Fig. 258.—Photomicrograph low power (125) of section through the tumor, showing its cavernous nature.

The 3 cases of angioma which have been reported are: A case reported by Zesas,[2] in a strong man of twenty-five, associated with attacks of sudden pain and swelling, subsiding under rest. There was no history of trauma or venereal disease. At operation a bloody effusion into the joint was found and the tumor mass invaded the overlying musculature. The pathologic report declared it to be a cavernous angioma.

A case of Reichel's[3] occurred in a carpenter of eighteen, without known cause, and with symptoms of two years' duration. At operation a blue-red tumor was found extending across the joint. The synovia was injected. The pathologic report declared it to be an angiofibroma.

The third case reported is by Oesser,[4] occurring in a man of thirty-three. The symptoms dated back to his youth, coming on at irregular intervals after slight trauma and after running. At operation the synovia and joint surfaces were reddish brown and there was some pannus formation in addition to the tumor. The pathologic report declared the tumor to be a cavernous angioma.

In all three cases, and in the fourth herein reported, the symptoms closely resembled those of an internal derangement of the joint or a foreign body. The embryonal and congenital theories of origin of these tumors make the association of a spina bifida in our case interesting.

An excellent article on tumors of the knee-joint has been written by Züllig.[5] It is evident from his review of the literature that angiomata of the knee-joint are rare but benign neoplasms, while sarcomata of various forms are much more common.

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CLINIC OF DR. ZABDIEL B. ADAMS

Massachusetts General Hospital

UNEXPECTED END-RESULTS FOLLOWING TREATMENT OF CONGENITAL DISLOCATION OF THE HIP

From a survey of the end-results, both functional and anatomic, following treatment of congenital dislocation of the hip there is a great opportunity for study and perhaps improvement of technic.

Whether the treatment has been by some open operation, or by one of the many methods of closed reduction, little interest has been taken in following these cases with a somewhat critical eye, to see where the defects in the method have arisen, with a view to correcting these defects and improving the end-result. The immediate result being satisfactory, that is, the head of the femur appearing to be lodged in the acetabulum, the method has been considered a success and has been continued without due attention to the subsequent bony changes and ultimate result. No attention has been paid to the fact that many of these hips, three or more years after reduction, show marked impairment of function, shortening, stiffness, or laxity, pain, weakness, etc., and that very many, in fact, nearly all, by roentgenologic examination, show imperfections of the head and socket of varying degrees of severity.

Another fact which must be acknowledged is that some of the cases where no treatment has ever been attempted, or where attempts at reduction have failed, or have resulted in a fixed hip in good position, report an excellent functional hip or hips practically without symptoms. We have known good walkers, skaters, and even ballet dancers in this class. Where the hip is ankylosed in good position there is every reason to believe that the good function, such as it is, will continue; but where the head is on the ilium, *i. e.*, posterior, the support is ligamentous, and difficulty may follow an increase of body weight or a trauma injuring these ligaments. Certain of these cases, on account of the extreme lordosis, develop back strain as age and weight increase.

In unreduced cases there is noted at times in the roentgenogram an increased flaring of the ilia, apparently giving somewhat more bony support. At times the roentgenogram shows an areola around the head, suggesting the formation of a bony socket on the outside of the ilium around the dislocated head. None of the postmortem specimens in the Warren Museum, however, show any such socket. Furthermore, in 2 cases where an attempt to furnish such a shelf or socket by a bone-grafting operation has been made, no success was achieved. In one of these cases the graft from the tibia was wholly absorbed.

Fully realizing that the soft parts—*i. e.*, the muscles and their tendons, the capsule and ligaments, joint and bone cartilages, which do not show in the roentgenograms—may play an important rôle in the difficulties of reduction, we have made a study of the roentgenograms before reduction has been attempted, with a view to determining the best method of treatment and the ultimate prognosis as to final result.

Another point which is important to determine, from a comparison of the roentgenograms before and a number of years after treatment, is whether the anatomic changes in the heads and acetabula so common in these final results are due to congenital defects, perhaps the cause of the dislocation, or to the trauma of reduction, or to prolonged pressure on the growing epiphysis during the fixation in plaster.

The reports of failure and success from the various operators vary widely. Professor Maurice Denuce reports for the clinic at Bordeaux, France, on 474 cases, comprising 725 hips, reduced by his method of manipulation, since the beginning of the War, in August, 1914. This method consists of: (1) Flexing the thigh across the trunk, the knee being flexed and placed toward the opposite axilla; (2) pressure downward on the knee, pushing the head of the femur behind the acetabulum; (3) the unhooking of the head, with the finger placed behind the trochanter head and neck; (4) circumduction of the thigh to a position, in the ordinary case, of 90 degrees flexion and 90 degrees abduction. Gentleness is the thing upon which Denuce insists.[1]

Of the 474 cases, 725 reductions, only 11 hips relapsed, and of this number 9 hips were re-reduced successfully. Against this statement we must put that of Dr. Galloway, of Winnepeg, who has abandoned the so-called "bloodless method," and operates on all by the open method. He reports as follows on 38 cases treated by open operation: "In 38 cases, operating by the anterior anterolateral route, or posterior route (Kocher), he cured 12, obtained good results in 14, failures in 6, and doubtful results in 6. In the cases he speaks of as cured not all the heads are in the acetabula, and they are far from anatomic cures. Under good results he includes those with stability and limited motion. Infection occurred in 6 out of the 50 operations.[2]

Another group of statistics comprises 639 individuals with congenital dislocation of the hip—78 of these were boys and 561 of them were girls. Still other statistics show that of 713 cases, 224 were double dislocations, 201 were single of the right hip, and 288 were single of the left hip.

In our series reviewed for the American Orthopedic Association, 286 cases have been studied, 369 hips. There have been 119 manipulative attempts, 65 by Dr. Bradford's machine, and 130 on the Hibbs table; 85 by the Lorenz stretching method, and 12 by open operation. The results show 266 hips reduced, 19 marginal, 2 anterior, 77 out, and 12 doubtful. The functional results of these patients are: 149 good, and walking without limp; 67 fair, walking with slight limp; 54 poor; 10 doubtful.

The roentgenograms before and at least three years after reduction have been compared in 91 cases. In 71 the postoperative roentgenograms alone were available. A very large proportion of the roentgenograms before reduction show small osseous centers in the epiphyses, torsion of the neck on the shaft which varies in its degree, and shallow acetabula with a poor shelf. Of the postoperative roentgenograms, it is fair to say that only a few show normal bony contours of head and acetabulum.

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[1] Le Traitement de la Luxation Congenitale de la Hanche à la Clinique Chirurgicale Infantile et Orthopedique de l'University de Bordeaux (Professor Denuce), par le Docteur Edouard Papin, Ancien Interne des Hôpitaux.

[2] Jour. Orth. Surg., July, 1920, vol. 2, No. 7, p. 390.

Fig. 259.—*Case P*. Six years old. Double hips. Good epiphyses, but slight torsion. Fair acetabula. Machine reduction August 30, 1919. Lorenz position.

The torsion present before operation disappears in some of these cases after reduction without a corrective osteotomy, but it persists in many, especially in those with much deformity of the capital epiphysis. The most common defects are the thinned and flattened and often displaced capital epiphyses, and the rough, irregular, imperfect acetabula. One may estimate the torsion, but it is impossible to gage the result and the difficulties of reduction from an inspection of the preoperative roentgenogram. Many of the deformed heads suggest a crushing force to the cartilaginous capital epiphysis, which force may be that exerted during reduction or subsequent holding in plaster. It is possibly a congenital defect. Some of the heads suggest that the epiphysis was loosened and slipped from its original attachment, and, in some cases, entirely knocked off and lost. These facts suggest that it would be a great advantage in our treatment to avoid the use of great force in reduction, be that force exerted by the machine, König's block, or manual force.

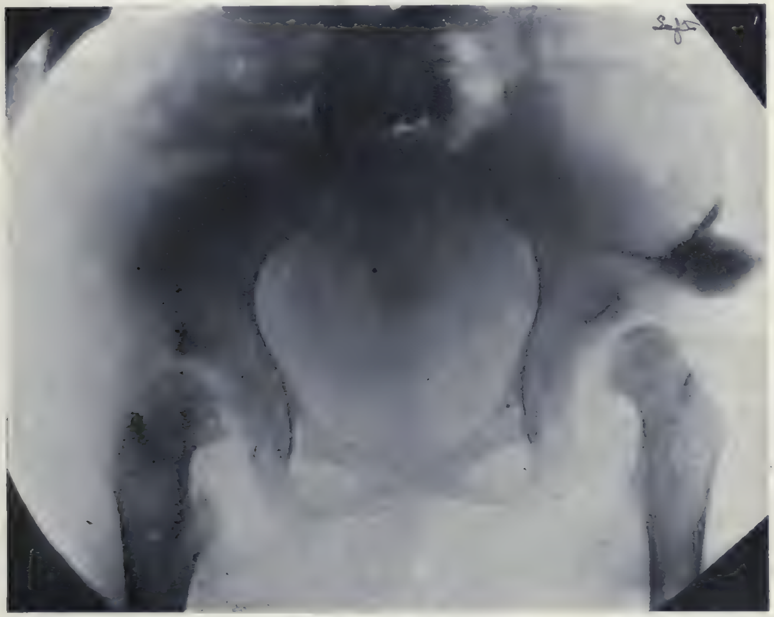

Fig. 260.—*Case P.* *x*-Ray thirteen months after an easy machine reduction. Click as head went into acetabulum. Note the changes in the heads, neck, and acetabula. After reduction the original plaster—extending from above the iliac crests to the toes (Lange's position, 90 x 90 degrees)—was worn four months, and then changed to another, exactly similar, in same position. This was worn for four months more, then the legs were released from plaster. Child somewhat thin during last two months of holding, but grew some in height. Were these changes due to longitudinal pressure from the growing femora, to the plaster capping the knees, or to traumata at time of reduction?

It is the hope of the writer to stimulate the surgeons throughout this country to record more accurate data as to just what is done in every case, and to record the end-results with accuracy as to the exact range of motion, shortening, atrophy, etc., with careful roentgenograms before and several years after reduction, to the end that we may improve our methods of treatment.

Congenital dislocations of the hip, when under six, can all probably be successfully reduced with a normal, or nearly normal, functional result. Let us have your assistance in developing this method.

There is one departure from the ordinary practice which has been found useful. The usual roentgenogram taken after reduction to determine the position of the head is an antero-posterior view, and even when stereoscopic this view may give an imperfect idea as to whether the head is in front of or behind the acetabulum. We have found extremely valuable another roentgenogram taken with the plate against the perineum, at right angles to the plane of the plate, as it is ordinarily placed, the rays coming from the side at about the level of the axilla in the plane of the hip-joint and passing down more or less parallel with the outer face of the ilium. A little study enables interpretation, and shows the anteroposterior relation of head to socket. It has been proved possible to lock a head behind the socket, and also to place it anterior to the socket, and have it appear in place in the ordinary roentgenogram.

CLINIC OF DR. MARK H. ROGERS

Massachusetts General Hospital

TRAUMATIC OSTEITIS OF THE WRIST

These 2 cases are presented for discussion because when they were first examined there was a good deal of uncertainty in regard to their true pathology, and because it was quite evident that this condition is not very well known. Both cases presented symptoms of stiffness, pain, and disability of the wrist-joint extending over a period of at least six months, and gradually increasing in severity. The onset was slow, the symptoms causing very slight inconvenience in the beginning, so that it was difficult to state when the first symptoms were noted. There was a definite history of trauma in one of the cases, but it was impossible to connect the trauma with the onset of the present trouble, while in the second case it was impossible to obtain any definite history of trauma.

Case I.—J. T. Age twenty-three. About nine months ago he began to complain of pain and stiffness of the right wrist after using it. At first the amount of discomfort was slight and did not prevent him from following his occupation as a mechanic. Later on he would have to stop work for a day or two, but after resting the joint would return to normal. Finally, the pain and swelling increased so that he stopped work.

The examination showed a healthy young man with negative findings except the right wrist. There was a slight swelling over the dorsum of the wrist, no heat, no redness, slight tenderness to touch over the head of the radius and the scaphoid. The motions of the wrist were limited chiefly in extension to 15 degrees of the normal, and any attempt to hyperextend caused pain.

The *x*-ray showed a normal wrist except as regards the scaphoid bone. The scaphoid shows a loss of substance of bone structure involving the central portion, with an irregularity and "crinkling" of the contour without any diminution in size and shape. There is no involvement of the contiguous carpal bones or the radius.

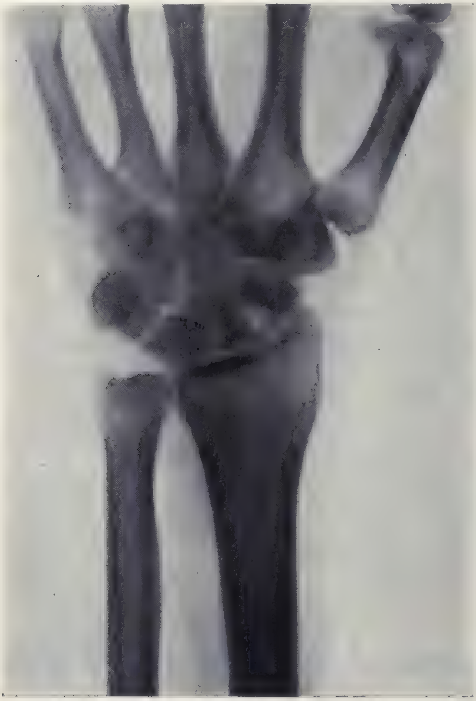

Fig. 261.—Case I.

On careful questioning in regard to injury he states that about two years previous, while in service, he sprained his wrist, and that it was treated by the application of tincture of iodin. There was no *x*-ray taken and evidently very little attention was paid to the injury. He used the wrist freely for a year, although he states that it was weak, and the present symptoms evidently developed after his discharge from the army.

Case II.—J. B. Age twenty-five. He complains of stiffness and pain in the right wrist for the last six months. The onset was gradual, and now he is unable to continue his occupation regularly on account of the increase in pain on use. If he stops using the wrist the pain diminishes.

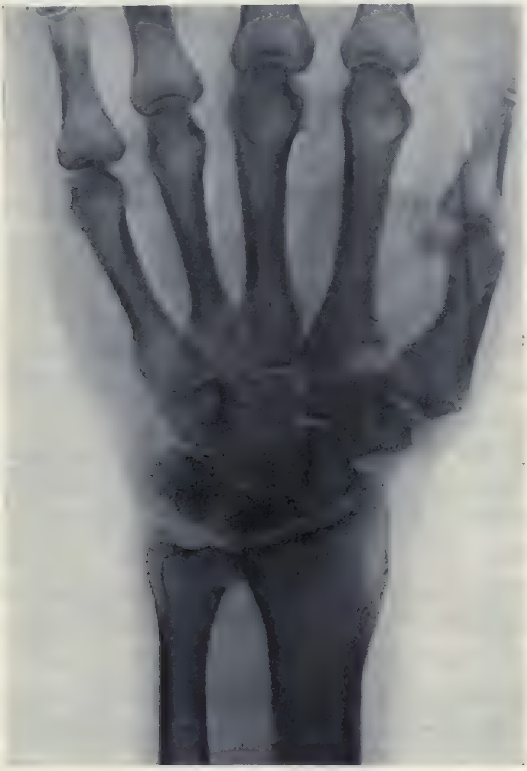

Fig. 262.—Case II.

The examination is negative except for the wrist. There is very little swelling. There is tenderness over the head of the radius and the carpal bones. There is limitation of motion chiefly in hyperextension and attempts of full motion cause very definite pain.

We could not obtain any definite history of injury. He could not remember any time when he injured his wrist to such an extent that he was compelled to stop work, although he did say that he had received minor injuries playing baseball. He did not connect an injury with the present condition.

The examination of the *x*-ray shows a lesion of the semilunar bone. It appears smaller than normal, with a rather typical "crinkled" appearance and a change of the structure of the internal bony structures. There is no evidence of involvement of the contiguous bones.

The problem of diagnosis of these 2 cases is most important. Tuberculosis, syphilis, infectious arthritis, such as would occur from gonorrhea, and fracture were considered.

Before the *x*-ray was examined tuberculosis was certainly considered as very possible in both cases. The slow onset and the progressiveness of the disability pointed toward a tubercular process, and the possible slight traumatic history was not inconsistent with tuberculosis. In the first case the swelling was diffuse enough to make it possible that the whole wrist-joint was involved.

In any peculiar bony lesion syphilis is always suspected. Nothing could be obtained from the history and the Wassermann reaction was negative in both cases.

The slow onset, the lack of involvement of other bones, and the lack of history of infection are against the diagnosis of infectious arthritis. It is not common for an infection to isolate one carpal bone except tuberculosis.

This brings us to the relation of trauma or fracture as a cause of such a condition. There has been described an absorption of bone as the result of a fracture of a cancellous bone, such as a carpus. But a very careful examination of the histories of these 2 cases does not indicate that there had been a fracture, certainly not a transverse fracture. The first case did connect his injury received in service with his present condition, but the second case put very little stress on his accidents, although he probably did receive injuries playing baseball. In either case it does not seem probable that there had been a gross fracture.

The scaphoid in the first case and the semilunar in the second case were removed by operation because it was not possible to control the symptoms by conservative methods. The first case had a thorough course of treatment for two months by physiotherapy and fixation, and the symptoms recurred on use. On incision there was no involvement of the capsule or neighboring joints as would be found in disease such as tuberculosis or infectious arthritis. The surrounding tissues were normal and clean. The laboratory report was negative for tuberculosis.

This condition has been described in the literature a few times, but is not mentioned to any extent in the text-books. Kellogg Speed's book on Fractures and Dislocations calls attention to it in relation to fracture of the scaphoid. Preiser[1] in 1910 reported 5 cases and calls it an osteitis as the result of trauma. He discussed the anatomy of the carpal bones and suggests that a slight trauma might shut off the nutrient artery and thus cause a secondary absorption of the bone. Guyé[2] in 1914 reports a similar condition, and explains it as primarily a compression fracture. These are the two best articles on the subject.

It is interesting to speculate as to the nature of this condition, which is evidently a clinical entity. In all probability there is an element of trauma, the immediate effects of which are not noticeable and often overlooked. But the secondary effect is really the cause of the disability. There seems to be an absorption process which takes place gradually, and this affects the cancellous portion rather than the articular surface. Preiser's explanation of injury to the blood-supply which causes the secondary changes is interesting and fairly convincing. We must also consider the theory that there has been an actual compression fracture with resulting secondary changes as put forth by Guyé. This last explanation seems to fit better if we can believe that a very slight injury can compress such a bone.

[1] Fortschrifte auf d. Geb. d. Roentgenstr., 15, Heft 4.

[2] Deutsch. Ztschr. f. Chir., Leipzig, cxxx.

CLINIC OF DR. M. N. SMITH-PETERSEN

Massachusetts General Hospital

TUBERCULOSIS OF THE SACRO-ILIAC JOINT

Tuberculosis of the sacro-iliac joint is generally looked upon as a chronic condition with a grave prognosis, even with the most ideal treatment. By the most ideal treatment I mean recumbency in a plaster or leather back for a year or more, accompanied by heliotherapy and followed by brace treatment and gradually increasing activity. A case so treated would theoretically be well in the course of two years if no complications occurred. Abscess formation, however, is a very common complication, resulting in chronic sinuses, secondary purulent osteomyelitis with frequently fatal outcome. Tuberculosis of the sacro-iliac joint is not a common condition; in the past three years only 8 cases have been diagnosed and treated at the Massachusetts General Hospital Orthopedic Department.

Tuberculosis does not thrive where there is no motion; this gives us the clue to our treatment of tuberculous joints. In children, where the time element is of comparatively little importance, and where we are dealing with epiphyses, conservative brace or plaster treatment carried on for years sometimes results in joints with limited motion. In adults, where the time element is of supreme importance, and where epiphyses and growth do not come into consideration, any procedure is justifiable which will shorten the duration of treatment and result in a functionally good extremity. Excision of the knee and arthrodesis of the hip are examples of such operative procedures used with good success. Arthrodesis of the sacro-iliac joint for tuberculosis, as far as known to the author, has not been described in medical literature. The chief reason is probably that the joint is so situated that it is not easily accessible except by very destructive operations. During the past three years an approach has been used by the author with uniformly good results in the treatment of tuberculosis of the sacro-iliac joint. (Reported before the meeting of the American Orthopedic Association, 1921.)

This operation consists in a subperiosteal reflection of a flap from the posterior two-thirds of the ilium down to the sacrosciatic notch, exposing its lateral surface. A rectangular window is then chiseled through the ilium just above the sacrosciatic notch, *i. e.*, within the projected sacro-iliac joint area. On removing this window the sacro-iliac joint surface comes into view and the greater part of its diseased portion may be removed. By replacing the block of bone removed from the ilium a dowel is formed across the joint which favors an early ankylosis. The flap is turned back in place and the incision closed in layers, without drainage.

Seven cases of tuberculosis and 6 cases of relaxed sacro-iliac joint have been treated by the above method of arthrodesis with gratifying results. The following case is a fair example of tuberculosis of the sacro-iliac joint so treated:

A. R. S. Age seventeen. *November 20, 1918.*

Occupation.—Lacer, shoe factory.

Family History.—No history of tuberculosis or known exposure.

Past History.—Positive findings have no bearing on present illness.

Present Illness.—Four months ago, while riding a bicycle, patient fell, striking right hip. Since that time there has been persistent pain in the region of the right "hip," at times very acute. There has been decided right-sided limp since the injury.

Physical Examination.—Young boy in poor physical condition, moving about evidently in great physical pain. Otherwise general physical examination negative.

Local Examination.—Hip motions: internal and external rotation free in extension; in flexion: rotation of the left, free, not accompanied by pain; on the right: markedly limited by muscle spasm and pain. Straight leg raising: limited to 45 degrees, both sides, by pain and muscle spasm. Motions of the spine: limited in all directions by muscle spasm and pain referred to the right gluteal region.

Rectal Examination.—Marked sensitiveness on the right side as compared with the left; some evidence of fulness in the region of the right sacro-iliac.

Stereoscopic *x*-rays taken of the low lumbar spine, sacrum, and sacro-iliac synchondroses. The right sacro-iliac synchondrosis in its lower portion shows a moth-eaten appearance with atrophy of the bone particularly on the sacral side, starting at the lower portion and extending upward about 1 inch. The left sacro-iliac synchondrosis seems normal. The irregularity and atrophy of the bone is very suggestive of a tubercular arthritis. The fifth lumbar seems normal (Fig. 263).

Treatment.—On the basis of clinical findings and *x*-rays arthrodesis was advised, but patient failed to enter hospital until February 1, 1919. At that time there had been distinct improvement in the local condition, but pain still persisted and arthrodesis was performed.

Operation, February 7, 1919.—Approach as above described. On reflecting the flap just above the sacrosciatic notch a tuberculous abscess was encountered. This was evacuated and packed with gauze sponge. A window was then cut through the ilium into the sacro-iliac joint, which was found to be extensively destroyed, the process involving even the posterior sacro-iliac ligaments. As a result of this extensive destruction there was abnormal mobility of the joint, so that it opened and shut like a book, synchronous with the respiratory movements. As much of the diseased portion of the joint and surrounding bone was removed as could be reached. The window was not replaced, as it was thought that it might form a foreign body in the mass of tuberculous tissue. The wound was closed in layers; no drainage. Double plaster spica applied.

Pathologic report of tissues removed from sacro-iliac joint:

Irregular fragments of bone showing on microscopic examination, atrophy of the trabeculæ with fibrosis and small round-cell infiltration of the marrow. There is a rare focal collection of epithelioid and giant-cells.

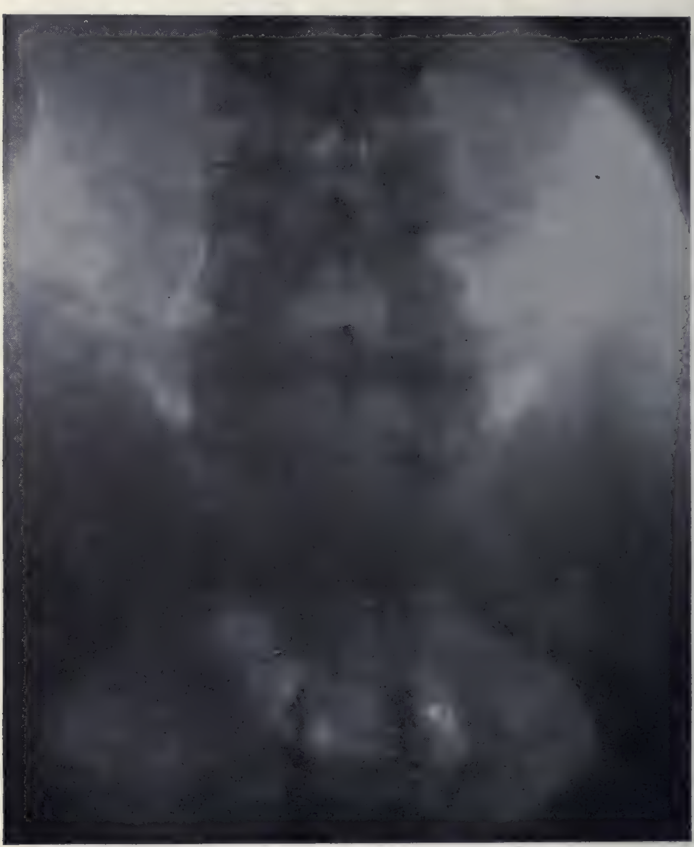

Fig. 263.—November 22, 1918. x-Ray three months before operation (M. G. H.).

Stereoscopic plates taken of the low lumbar spine, sacrum, and sacro-iliac synchondroses. The right sacro-iliac synchondrosis in its lower portion shows a moth-eaten appearance with atrophy of the bone particularly on the sacral side, starting at the lower portion and extending upward about 1 inch. The left sacro-iliac synchondrosis seems normal. The irregularity and atrophy of the bone is very suggestive of a tubercular arthritis. The fifth lumbar seems normal.

Postoperative History.—Convalescence was uneventful up to March 2d; on this date a superficial sinus was found in the line of the incision. As time went on, others formed. They were treated by dichloramin-T, and gradually cleaned up.

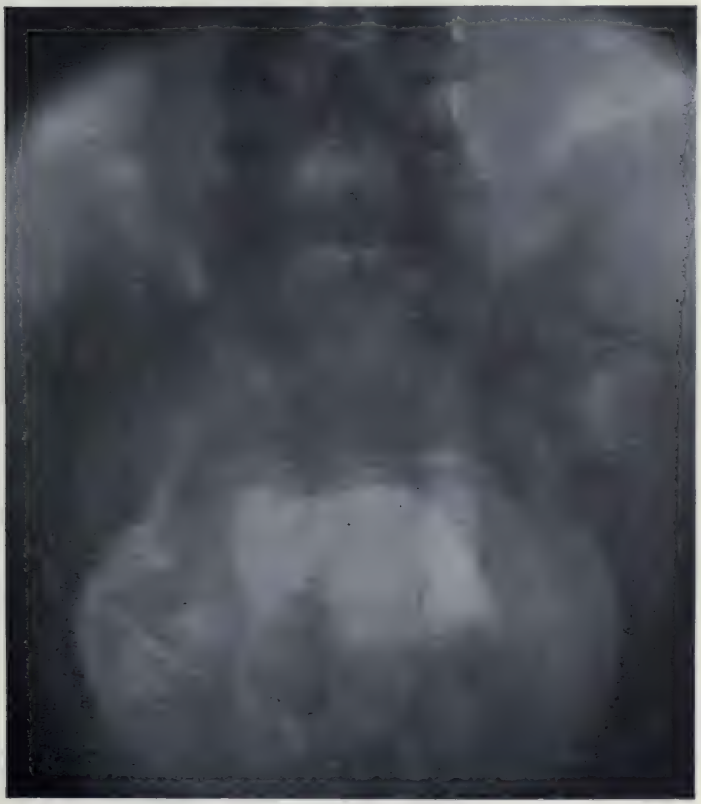

Fig. 264.—April 2, 1919. *x*-Ray two months after operation (M. G. H.).

Plate taken shows an area where the bone was removed in the ilium just in from the posterior spine; there is slight erosion on the lower portion of the sacro-iliac synchondrosis.

x-Ray Taken April 2d.—Plate taken shows an area where the bone was removed in the ilium just in from the posterior spine; there is slight erosion on the lower portion of the sacro-iliac synchondrosis (Fig. 264).

On May 1st patient was discharged with a small dry dressing and a webbing belt. During the following months activity was gradually increased. Sinuses closed entirely, and have not recurred, nor has there been any recurrence of pain or tenderness in the region of the joint or the operative field.

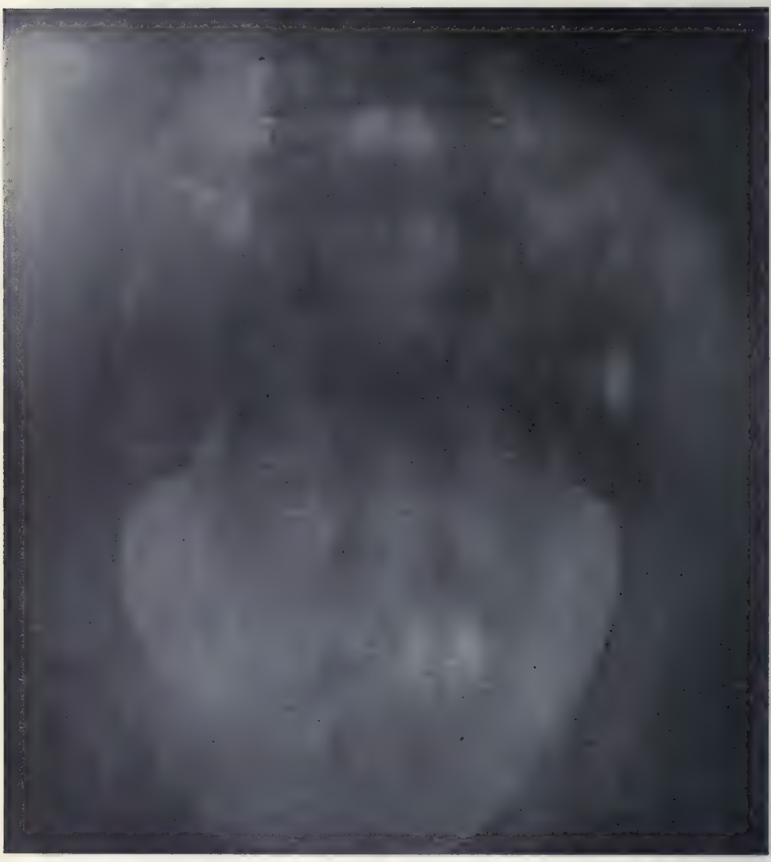

Fig. 265.—January 22, 1921. *x*-Ray two years after operation.

There is an opening at the site of operation with the edges of the bone apparently healed. There is a slight irregularity on the very lower portion of the sacro-iliac synchondrosis; above this the area is normal and there is fusion of the sacro-iliac articulation immediately adjacent to this area.

Through the aid of the Massachusetts General Hospital

Social Service Department the boy was financed through a course of wireless telegraphy and is now a licensed wireless telegrapher. His general condition is excellent; his local condition leaves nothing to be desired.

x-Ray Taken January 22, 1921.—There is an opening at the site of operation with the edges of the bone apparently healed. There is a slight irregularity on the very lower portion of the sacro-iliac synchondrosis; above, the area is normal and there is fusion of the sacro-iliac articulation immediately adjacent to this area (Fig. 265).

Dr. L. B. Morrison, of Boston, has been good enough to interpret the *x*-rays, so that an unprejudiced opinion might be obtained.

CLINIC OF DR. PHILIP D. WILSON

Massachusetts General Hospital

THE SYME AMPUTATION

D. W., male, aged thirty-nine, and a farmer by occupation, was admitted to the Massachusetts General Hospital March 1, 1920 (Record No. Orth., 235,409) because of pain and swelling in the left foot. The family history was negative for tuberculosis and the patient had always been well and strong except for the trouble from which he is now seeking relief. He is unmarried and denies syphilitic infection both by name and symptoms.

He states that at the age of twelve inflammation developed in the forepart of the left foot which was called "periostitis." This illness was so long ago and he was so young at the time that he can recall little about it except that the foot was in a plaster cast for two years and that after the cast was removed an abscess developed and ruptured spontaneously. There was a discharging sinus for seven years, but he used the foot actively during this period. From then until about two years ago the foot caused no trouble, save that two or three times an abscess developed in the same locality as the original one, which, after rupturing, healed in a short time and caused but little interference with function. The last time this occurred was about five years ago.

Two years ago the left foot was injured by a log rolling on it. It was so swollen and painful that he stayed in bed for two days. He then resumed work, but after three weeks the pain increased to such an extent that he came to the Out-patient Department of the Massachusetts General Hospital for treatment. Here the foot was immobilized in plaster for several months and then became so much better that he could walk on it. Several months later he "sprained his foot," with recurrence of the pain. The trouble continued with alternating periods of exacerbation and improvement until five months ago, since when it has been growing definitely worse, and the foot has become hot, red, and swollen.

Examination of the patient was negative, save for the left foot. This was considerably swollen, but most markedly so over the region at the base of the fourth and fifth metatarsals and over the cuboid. There was marked tenderness on pressure over this area on the dorsum of the foot, less marked on the plantar surface. There was slight heat, but no redness, slight bony thickening, and all the motions of the foot seemed free, except for the limitation caused by pain.

The radiogram showed an area of lessened density due to a destructive process involving the cuboid, cuneiforms, and the proximal portions of the third, fourth, and fifth metatarsal bones. When compared with a radiogram made two years previously it showed considerable extension of the disease.

In view of the long history and the definite inflammatory character of the lesion the differential diagnosis rested between three types of bone infection—tuberculosis, syphilis, and chronic osteomyelitis. The Wassermann reaction had been tried on three occasions and was always negative. This, with absence of history of personal or family infection, seemed to rule out syphilis. The normal temperature and the failure of the radiogram to show sequestra or proliferative changes in the bone characteristic of osteomyelitis pointed against the latter. This left tuberculosis as the final diagnosis, and in favor of it were the long latent character of the lesion, the purely destructive nature of the bony changes, and a strongly positive Von Pirquet skin tuberculin reaction, although too much consideration should not be accorded the latter.

The involvement of practically the entire distal row of the tarsal bones as well as portions of the outer three metatarsals precluded any attempt at a conservative operation. The resulting foot would have been functionally useless and infinitely less desirable than a modern artificial one. Radical removal of the disease was indicated and amputation was the only procedure that would accomplish it.

This raises an important question which frequently confronts the surgeon. What is the best level for amputation of the leg when the lesion which necessitates radical removal is confined to the bones or other tissues of the foot? Happily, the time has almost completely passed when this question received its answer, By amputation at a point 4 inches below the knee or at the traditional "seat of election." It was only the war with its thousands of amputations that revealed the ignorance in which our profession rested with respect to artificial limbs. The "seat of election" dates from the time of the bent knee peg-leg when a long stump projecting behind constituted an unsightly and disgraceful monument to bad surgery, and yet it will be found advocated in all but the very recent text-books of surgery.

The war showed the surgeon the necessity of exchanging ideas with the limb maker, and at the same time provided a rich field for the study of end-results. The comparative value of amputations at different levels has been definitely established, and every surgeon must acquire this knowledge because it is of the greatest practical importance to future patients.

A great variety of foot amputations have been described, the best known being the Lisfranc, the Chopart, the Pirogoff, and the Syme. All have been designed as substitutes for amputation of the leg. Let us now consider how well they achieve this purpose.

In the first place it should be stated that amputation through the leg when properly performed gives a result in itself excellent. The best level is at a point 8 inches below the knee. This represents the consensus of opinion expressed at a meeting of the Association of Artificial Limb Makers held at Washington during the war. Weight bearing is primarily upon the shelving under surface of the bony prominences at the top of the tibia, secondarily upon the conically shaped soft parts of the stump. Weight bearing at the end of the stump is of little value and seldom utilized. A stump of this length has good leverage power and is readily fitted by any limb maker. The leg is of willow and weighs about 5 pounds. The disability from this amputation is rated in the army at 40 to 50 per cent., but is usually much less. All except heavy laboring work can be done almost as well as before amputation. The chief difficulty comes from callous spots that develop at the chief bearing points. Walking is apt to be more difficult in hot weather, when the stump, which is badly ventilated, perspires freely, and the resulting moisture causes chafing of the skin.

The Lisfranc amputation or disarticulation at the tarsometatarsal junction with long plantar flap gives a foot that is quite satisfactory for weight bearing and which requires for apparatus only an ordinary shoe with the toe stuffed with felt. Unfortunately, its practical value is small, because it can only be used in cases where the disease or injury is confined to the extreme forefoot. The former cases are rare, while the latter, although common enough, are unsuitable because the plantar surface is usually involved in the injury and a healthy plantar flap is the *sine qua non* of a successful result.

The Chopart amputation or disarticulation through the midtarsal region gives an unsatisfactory result in almost every instance and ought to be abandoned. This operation destroys the muscle balance of the foot, with the result that the heel draws up and the foot rolls inward, producing a position of equinovarus. The weight is borne directly on the forward angle of the stump and is commonly painful, while the foot is also unstable laterally. It is impossible to fit any appliance that makes the result more satisfactory, while tenotomy of the tendo achillis and arthrodesis of the subastragaloid joint improve, but do not entirely correct the condition. The final disability is commonly greater than with amputation through the middle of the leg.

The Pirogoff amputation has been little practised in this country, but at one time had a great vogue in Europe. It is, in reality, a modification of the Syme, and consists in amputation of the leg just above the malleoli, with preservation of a long plantar flap and implantation of the posterior portion of the os calcis on the ends of the cut bones. When it succeeds this gives a stump that is capable of direct end-weight bearing, but in a fairly large percentage of cases non-union of the transplanted portion of bone occurs, with resulting failure. The chief difficulty, however, lies in the fact that the stump is too long. There is a certain minimum requirement of room necessary for providing a satisfactory ankle-joint mechanism, and the distance between the end of the stump and the ground in this instance is insufficient.

Of the host of other partial foot amputations which have been suggested nothing further need be said; the oblivion in which they rest is the best indication of their complexity and lack of success.

There remains, however, one procedure to be considered, the very great value of which has been conclusively proved by war experience. This is the supramalleolar amputation by the classical method of Syme.

It was first described by Sir James Syme, of Edinburgh, in 1843, and was intended as a substitute for amputation of the leg in the radical treatment of tuberculosis involving the tarsus or ankle-joint. In those pre-Listerian days amputation of the leg was an operation attended by a high mortality, and the new procedure carried less risk and gave a better result than could be obtained with the kneeling peg-leg. The discovery of the cause of wound infection and its elimination from surgery came before the Syme operation was widely known. Amputation of the leg recovered its vogue, and this was still further stimulated by the excellent results obtained with the new type of artificial leg. In the complete absence of comparative end-result studies it is of little wonder that the surgeon followed the path of least resistance and that the procedure of Syme was gradually forgotten everywhere, except in the country of its inventor.

The chief merits of the operation are: 1. That it provides a stump capable of transmitting the entire body weight to the ground by direct end pressure without pain.

2. That it removes only the foot, and therefore leaves a stump of the greatest leverage power.

3. That it is less crippling than the common amputation of the leg. There is less sense of mutilation, because the patient is independent of his apparatus and can walk about his room on the bare stump, a convenience of great importance on many occasions.

The chief disadvantages are that the stump is bulbous, which makes the appearance of the ankle thick and unsightly when the apparatus is worn, and that the legs supplied by the artificial limb makers are heavy and clumsy. My reply to these objections is that when the operation is properly performed the stump is not markedly bulbous and that it is comparatively easy to construct a leg that meets not only the cosmetic difficulty, but answers all other requirements admirably. The disability that results from a good Syme amputation, equipped with a suitable appliance, is so slight that the patient is able to resume any occupation, no matter how laborious. There are numerous instances on record of men who have participated in long tramping trips, marched in full equipment with troops, and engaged in other kinds of difficult labor without their comrades being aware of their infirmity. The evidence justifies the statement that where the Syme amputation meets the indications it is to be preferred in all instances to amputation of the leg.

In the case mentioned above the Syme amputation met all the requirements. It allowed radical removal of the disease and yet permitted the hope of eventual return of the patient to his farming occupation, which amputation at a higher level precluded.

Two factors are essential for the success of the Syme amputation, both of which were present in this instance:

1. The skin covering the bottom of the heel must be healthy and undamaged.

2. Acute sepsis and foul sinuses neighboring the operative field must be absent in order to prevent contamination of the wound. Wound infection practically always causes failure.

Accordingly, the patient was advised to submit to the Syme amputation. He consented readily, as his mind had been prepared for the loss of the entire leg.

The operation was performed March 4, 1920, under ether anesthesia. The patient made an uneventful recovery and was discharged March 25th, with his wound entirely healed and walking on a temporary peg-leg. At the end of two months he was fitted with his permanent limb and returned to his home. Only recently I received word that he is working as a farm laborer and apparently as active as ever.

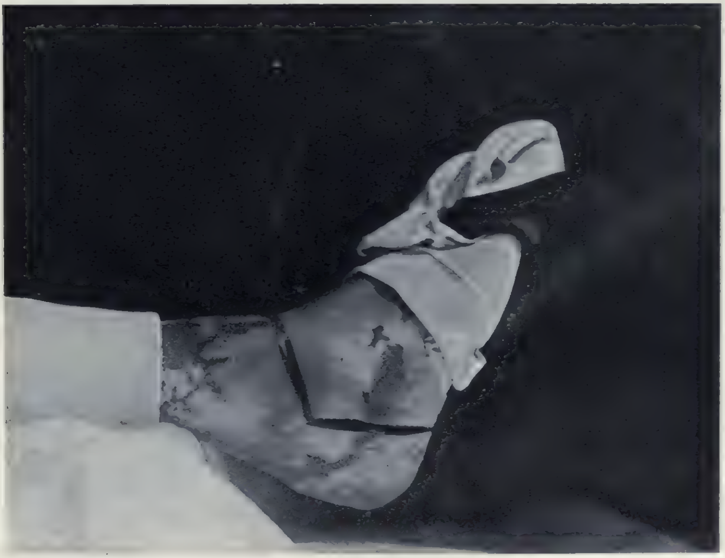

Fig. 266.

As the technic of the operation and after-treatment are important, a detailed account of them is given.

Operation.—A tourniquet is always used. The forepart of the foot is grasped by the left hand and traction exerted on it in a forward and downward direction during the entire first stage of the operation, that is, until the complete removal of the foot. This greatly facilitates the operation and makes assistance almost unnecessary.

A straight incision is made extending from the tip of the external malleolus directly downward and across the plantar surface, then up the mesial surface of the ankle, terminating ½ inch below the tip of the internal malleolus. The two upper ends of this incision are then connected by a slightly curved incision with the convexity upward running across the dorsum of the foot just below the level of the articular surface of the tibia. This incision opens the tibio-astragaloid joint across its entire width. The knife is then inserted in the joint and the external and internal lateral ligaments divided, which allows the foot to be displaced forward and downward (Fig. 267). This exposes the posterior capsular ligaments which are cut close to their insertion in the astragalus, and the dissection carried backward and downward over the top and posterior portion of the os calcis, keeping in as close proximity to the bony surface as possible (Fig. 268). The tendo achillis is divided at its insertion and the entire foot finally freed and removed from the leg, leaving only the posterior heel flap.

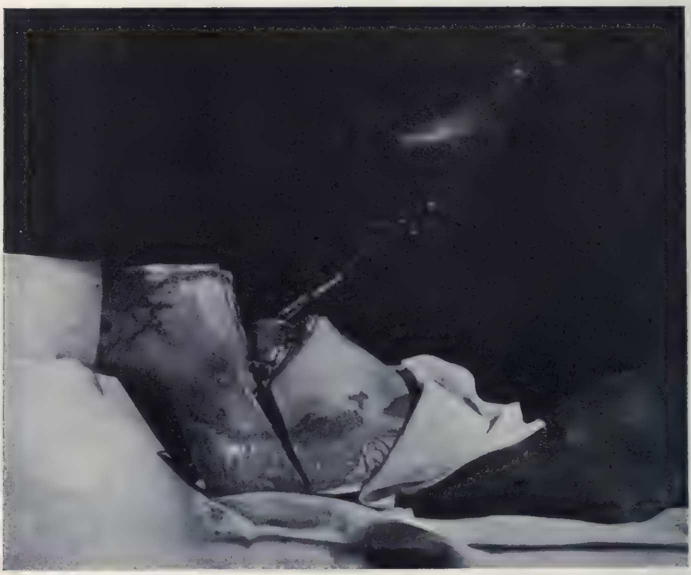

Fig. 267.

The next step is to free the upper flap by dissecting away the tissues covering the lower ends of the tibia and fibula (Fig. 269). This flap is then retracted and the articular surfaces, including the two malleoli, removed with the saw (Fig. 270). It is important to apply the saw at an exact right angle to the axis of the limb, otherwise a sloping surface results and the weight is borne too much on one point for comfort. The bones should be sectioned high enough to obtain the smallest possible diameter of bony surface, and yet low enough to pass through a point where they are still in close contact and held firmly together by the tibiofibular ligaments. This reduces the size of the end of the stump and improves the cosmetic result. This level corresponds to a point about ½ inch above the articular margin.

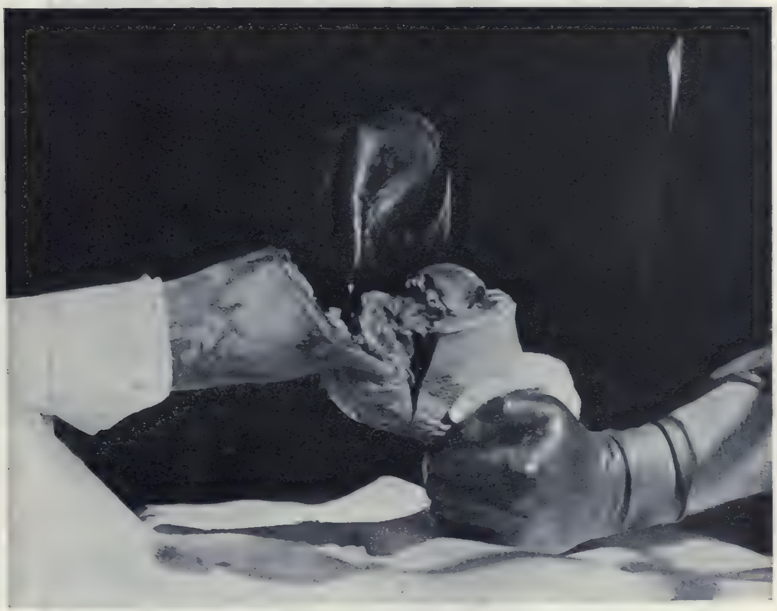

Fig. 268.

I am firmly convinced of the utility of the aperiosteal method of treating the bone ends in order to prevent spur formation, and am in the habit of applying it in all clean amputations.

By this method the bones are denuded of a cuff of periosteum ½ inch wide at their distal extremity. The sharp bony edge is then rounded off with a rasp.

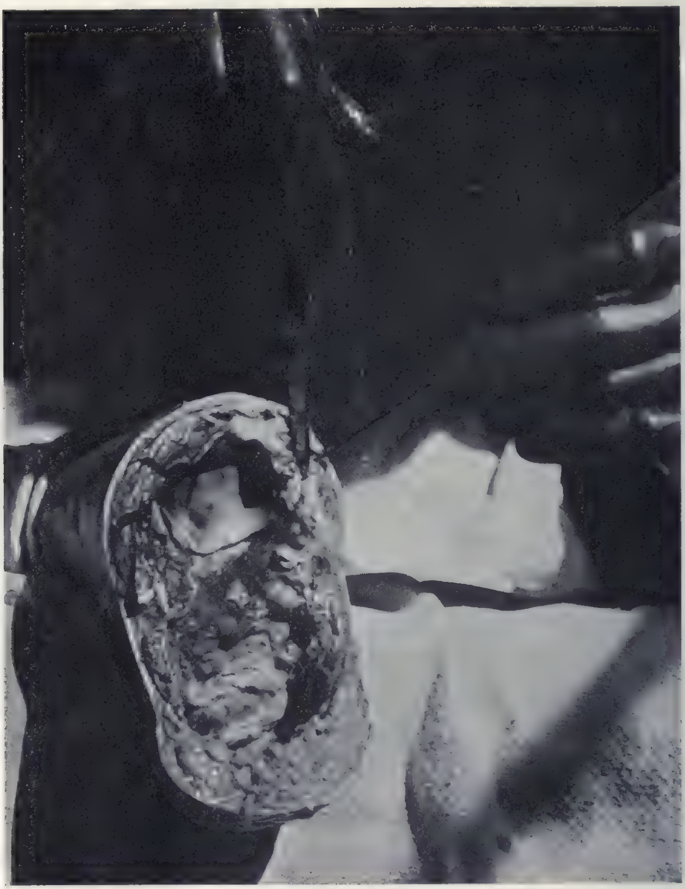

Fig. 269.

The principal nerves, consisting of the posterior tibial, musculocutaneous, and lateral cutaneous, are now identified, pulled down, and sectioned after previous injection with 95 per cent. alcohol, which Hüber has shown is the surest method at our disposal for preventing the development of neuromata.

The projecting tendon ends are trimmed away, the vessels ligated, the tourniquet removed, and all bleeding checked.

We now come to one of the most important parts of the operation—the closure. One of the chief reasons for failure of the operation in the past is that the terminal flap is left too redundant, with the result that it rolls under the stump in bearing weight, thereby causing instability. This fault also makes fitting of the appliance more difficult. It can be avoided by careful plastic closure of the skin, trimming away all superfluous tissue, in order to make the flap fit firmly (Fig. 271).

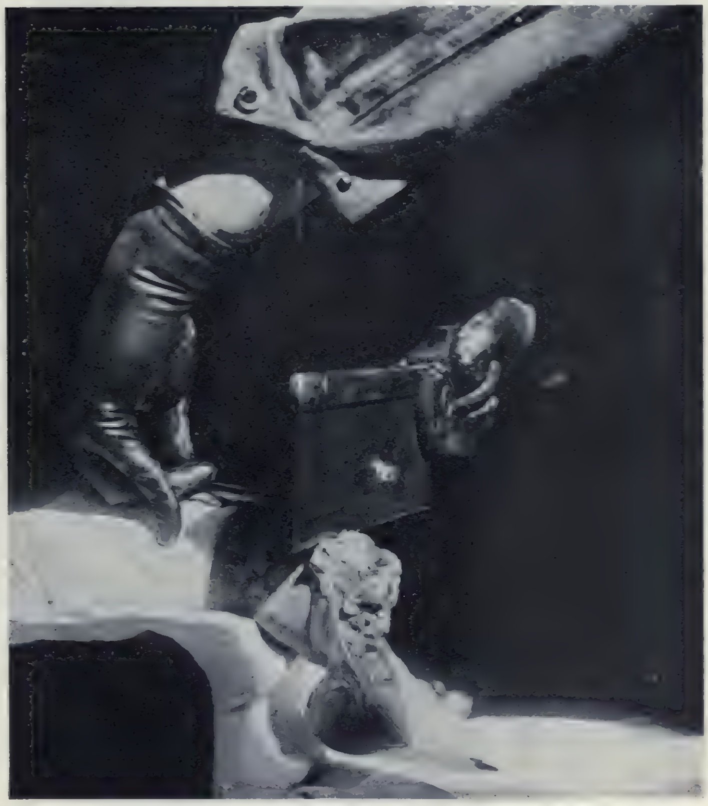

Fig. 270.

Especial care should be paid to the removal of projecting tabs at the angles of the wound (Fig. 272).

Throughout the entire operation great care must be taken to avoid injury to the posterior tibial artery as it descends behind the internal malleolus and the mesial side of the ankle. The heel flap is dependent for its blood-supply on the internal calcaneal branch of the posterior tibial artery which is given off just before the latter bifurcates into the internal and external plantar vessels, at a point about 1 inch directly below the tip of the internal malleolus. If the artery is cut above this point the edge of the plantar flap sloughs over an area nearly an inch wide, with distressing delay in wound healing. This accident may be prevented by making the original incision according to the directions given above and keeping the dissection on the

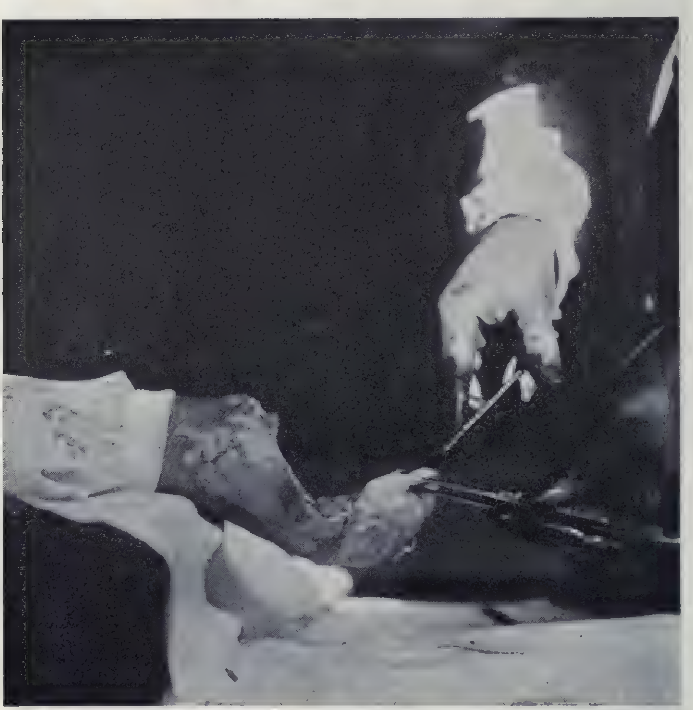

Fig. 271.

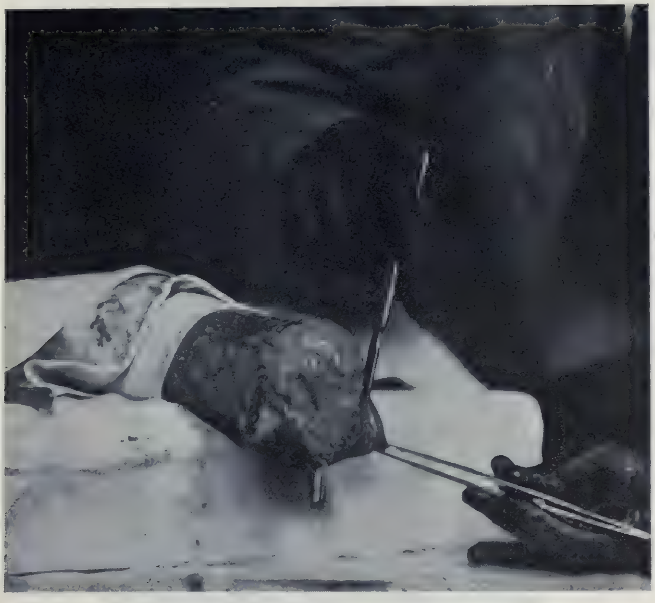

Fig. 272.

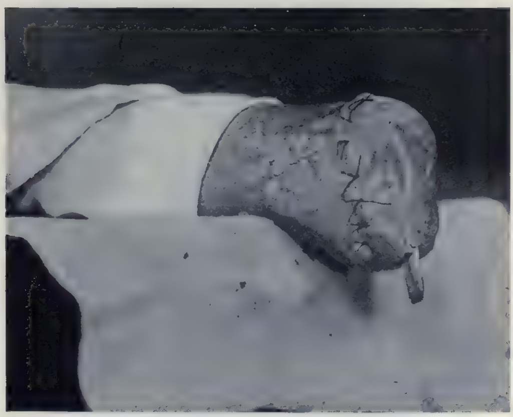

Fig. 273.

mesial side of the ankle as close as possible to the bone. The danger involved in trimming away tissue from the mesial aspect of the heel flap in order to obtain more perfect closure may be removed by separating the skin from the underlying fascia

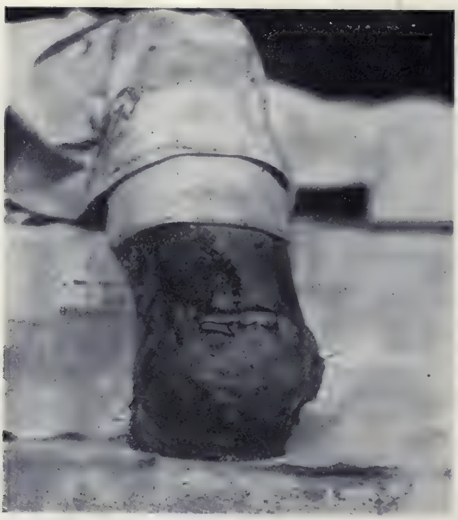

Fig. 274.

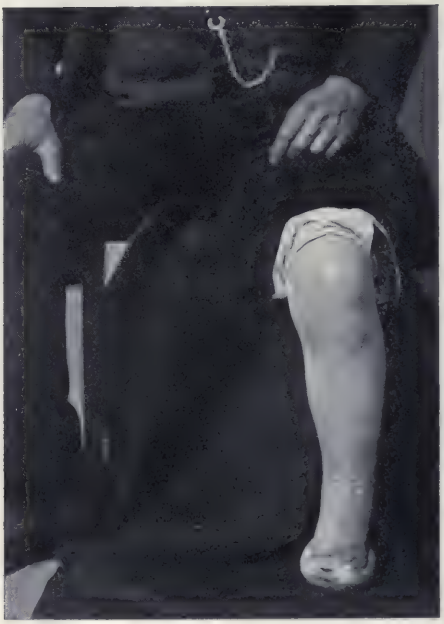

Fig. 275.—Syme stump with redundant terminal flap. Weight-bearing ability is good, but cosmetic result poor. Requires large clumsy appliance.

and confining the plastic work to the skin. The vessels lie below the fascia and may be infolded without harm in approximating the skin margins.

Closure is by interrupted silk sutures and careful approximation should be obtained. Drainage is provided by folded rubber tissue passing through a stab opening in the posterior portion of the heel flap. The suture line in front should lie above the cut margin of the bone (Figs. 273, 274).

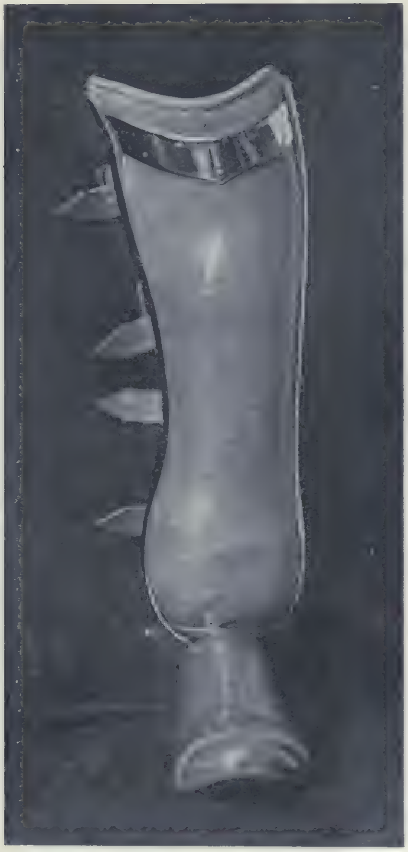

Fig. 276.—Type of appliance fitted to preceding stump. Ankle is unsightly and requires modification of the upper part of the shoe.

The wound is covered with a small quantity of dry sterile gauze, and a sterile bandage soaked in alcohol is applied as tightly as possible over this. The bandage can be applied more tightly when wet, and the alcohol evaporates rapidly. Provision should be made for the removal of the drain without necessitating disturbance of the bandage. The leg should be elevated when the patient is placed in bed.

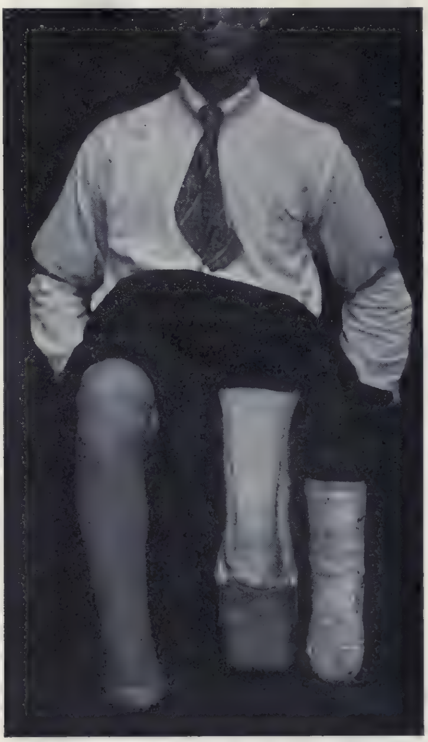

Fig. 277.—Good Syme stump. Very little terminal enlargement, and close-fitting flap. Shows also the temporary plaster peg-leg used in this case.

The drain is removed in forty-eight hours and the stitches at the end of twelve days. At this time the stump is strapped securely with strips of adhesive plaster.

At the end of fourteen days the patient is ready to begin weight bearing. A temporary peg-leg is then made in the following manner: A plaster cast is applied to the stump extending upward to just below the knee. Two pieces of strap iron

$\frac{3}{4}$ inch wide and $\frac{1}{8}$ inch thick, bent to conform to the mesial and lateral surfaces of the cast, are applied and fixed in this position by additional turns of plaster bandage, with their lower ends projecting about 3 inches below the end of the cast. When the cast has hardened the anterior portion is cut out and the stump withdrawn. A block of wood of the proper length to compensate for the portion of the limb removed is then fitted between the projecting ends of the iron bars and fixed by screws passed through holes drilled in the latter.

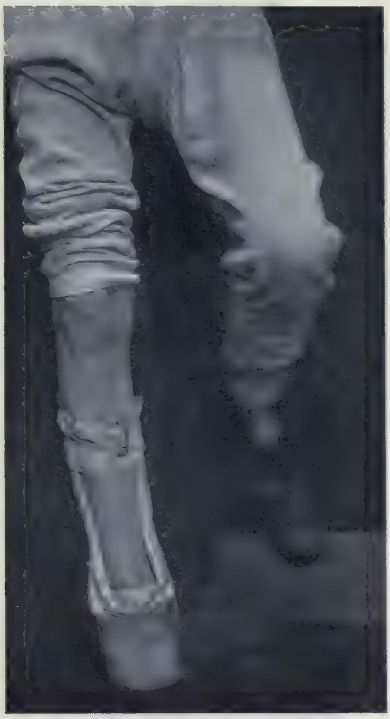

Fig. 278.—Same patient standing in his plaster appliance. All the body weight is being borne on the end of the stump.

The patient quickly learns to walk about in this leg, which is held in place by buckle straps or bandage. As the end of the stump develops in ability to bear weight successive layers of felt are inserted in the bottom of the cast until finally the entire weight is being borne in this manner.

At the end of two months of active use of the temporary leg the patient is usually ready for the application of his permanent limb. The leg developed at the Army Orthopedic Hospital at Toronto, Canada, is the most satisfactory type of apparatus I know and answers every requirement. Through the kindness of Colonel Starr I obtained the mechanical drawings of this leg and am now using it instead of the ordinary leg with wooden socket. The socket is made of heavy cowhide molded over a plaster model of the stump. It is reinforced with tempered steel bands on its anterior and posterior surfaces, and these are connected to the wooden foot by means of a simple ankle mechanism. The apparatus combines the qualities of lightness, simplicity, and meets the cosmetic objection better than any leg I have seen.

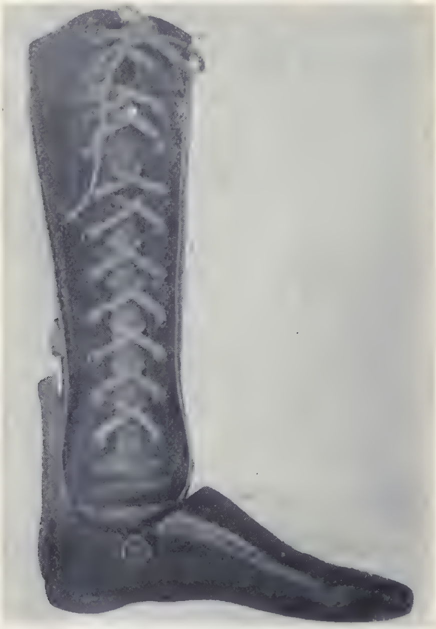

Fig. 279.—Canadian type of artificial limb for Syme amputation. (Photograph of Col. C. L. Starr.)

CLINIC OF DR. RAFE N. HATT

Massachusetts General Hospital

SPASTIC PARALYSIS

NEUROTOMY (STOFFEL OPERATION) AS A METHOD OF TREATMENT

The term "spastic paralysis," as generally used, conveys the idea of the various pareses of congenital origin. By more liberal interpretation, however, it denotes a condition of spasticity irrespective of etiologic factors. This latter conception obtains in the following discussion.

Restoration of power balance and correction of deformity are the indications for surgical intervention in the treatment of spastic paralysis. These indications are obviously identical to those governing the operative treatment of the flaccid paralysis most commonly associated with anterior poliomyelitis. This is not strange, for while the one represents the physiologic antithesis of the other in so far as the muscular element is concerned, the ultimate underlying processes are similar, namely, a loss of voluntary control, destruction of power balance, with deformity as the concomitant result.

The loss of voluntary control in both types of paralysis is due to a break-down in the neuromuscular mechanism. The determining difference between the two lies in the anatomic localization of the break. In the spastic type the regulator apparatus (suprasegmental neurone) is damaged and the motor or effector part remains intact from a histologic point of view. The condition is a paresis. In the flaccid type the effector part is the site of injury (segmental neurone plus muscle). There is a disintegration of the motor itself—a true paralysis.

This bit of elementary neurology contains the fundamentals for rational surgical procedure. The paralyzed muscle must be attacked directly. If contracted, it must be lengthened. If its function is of sufficient importance, it may be replaced by another muscle, or even the part which it normally helps to control may require stabilization by arthrodesis, splinting, etc. Before taking up the question of treatment in spastic paralysis it may be well to consider certain definite anatomicopathologic aspects, although the general pathology is too familiar to merit discussion here.

1. Spastic paralysis results from lesions of the suprasegmental or upper motor neurone. Such lesions may be classified briefly as:
    (*a*) Congenital—"Little's disease."
    (*b*) Tumors.
    (*c*) Disease—sclerosis, myelitis, etc.
    (*d*) Traumatic—fractures, etc.
2. The reflex arc is unimpaired.
3. The condition is a *paresis*—not a paralysis.
4. Spasticity represents a state of muscle hypertonus due to impairment of cortical inhibitory control, as evidenced by a lowering of the reflex threshold to stimulation.
5. Deformities are the result of the spastic exaggeration of the physiologic predominance of certain muscle groups over their antagonists. Rarely is it due to a true fibrous contraction.
6. A muscle is an aggregation of fibers, and each of these fibers receives a nerve process. Thus, a muscle may be said to represent so many neuromuscular units, and an approximation of their value may be mathematically expressed.

A conception of logical treatment now follows. To repair the regulator apparatus would be ideal. Unfortunately, however, it is not possible. Since the reflex threshold cannot be raised in this manner, the remaining proposition is to diminish stimulation—a matter of no great difficulty through accessibility of the reflex arc. Two methods of surgical approach are available: Posterior rhizotomy—Foerster's operation; neurotomy of the peripheral nerve—Stoffel's operation.

The anatomic basis for the latter operation was developed by Adolph Stoffel in 1909, following a survey of end-results in treated congenital cases. Stoffel was impressed with the frequent failures of customary measures: myotomy, tenotomy, transplantation, etc., and sought a means that might yield a more permanently satisfactory result. An investigation of the large peripheral nerve-trunks revealed a cable-like structure which permitted isolation of the various funiculi prior to their emergence as individual muscle or sensory branches.

Stoffel charted many of the larger trunks with a moderate degree of accuracy. The "nerve pattern," as he termed the arrangement of funiculi within the cable, is not invariable, as Stoffel at first supposed, but it shows no greater variation than one encounters in the muscles, and infinitely less than one finds in the case of arteries. The relations are, therefore, sufficiently constant to meet the demands of precise surgical measures. Personal observation on dissecting-room material during the past three years, with investigation of nearly 100 subjects, has been in accordance with this statement. Furthermore, it is significant that nearly all late reports on nerve suture recognize the utility of the nerve pattern.

The operation consists in exposure of the nerve trunk at a convenient level. The nerve sheath is carefully divided with meticulous regard for hemostasis. With small forceps, or a Moll dissector, the funiculi to be resected are isolated from neighboring bundles. Bearing in mind the delicate structure of axis-cylinders, one hardly need be cautioned to avoid rough handling, stretching, or crushing with forceps during this step. It is true that nerve tissue will withstand considerable insult, but since in most cases results depend in no little degree upon deliberate quantitative destruction, it is well to leave as little as possible to hazard. When doubt exists as to the identity of the funiculus, stimulation by means of a weak electric current produces contraction of the muscle supplied. The current must be nearly minimal, since strong stimulation overflows and may lead to error. Having freed the funiculus for 3 or 4 cm., a portion is resected. The amount to be destroyed depends upon the following factors:

1. The degree of spasticity.
2. The state of the antagonist.

3. An estimation of the neuromuscular units. (The size of a muscle nerve is directly proportional to the number of muscle fibers. Hence, a muscle small in bulk, but of fine structure, *e. g.*, the flexors of the fingers, has a relatively larger supply of nerves than another muscle many times its size, but of coarse texture, *e. g.*, the glutei. Therefore, no set rules can be formulated from these variants, but the matter must rest upon the experience of the operator and his exact anatomic knowledge.) The proximal stump of the resected segment may be transplanted to the superficial fascia to obviate the possibility of regeneration. The sheath is repaired, the wound closed, and ordinary sterile dressing applied. Immobilization or restrictive

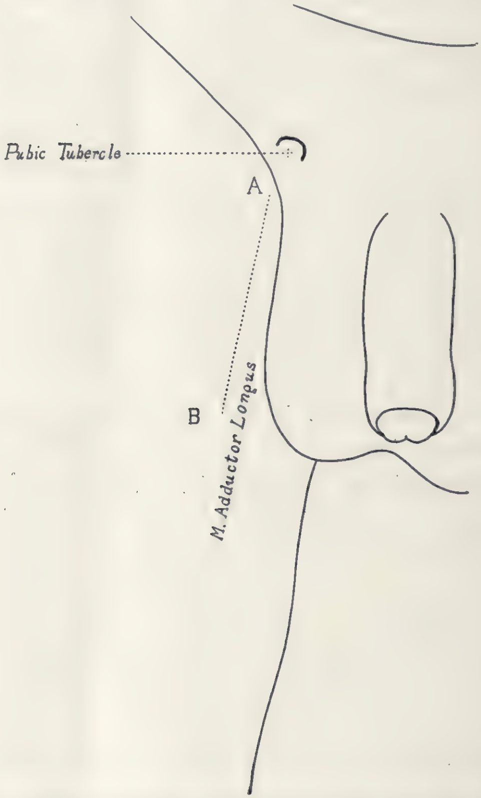

Fig. 280.—A–B, Line of skin incision for exposure of N. obturator.

dressings are inadvisable, owing to a temporary general increase in spasticity from the operative trauma. Held in restrictive dressings, this temporary aggravation sets up a cycle of stimulation and reaction which causes great discomfort and prolongs the postoperative convalescence. The period of reflex activity subsides within a short interval and active physiotherapy should immediately follow. The operation does not effect a cure in the same sense as an appendectomy or herniotomy, but bears a close relation in this respect to the tendon transplantations in treatment of flaccid paralysis. The real value in both cases lies in rendering the part more susceptible to effective after-treatment, in shortening the period of after-treatment, or both. Co-ordinate muscle action is the chief objective in after-treat-

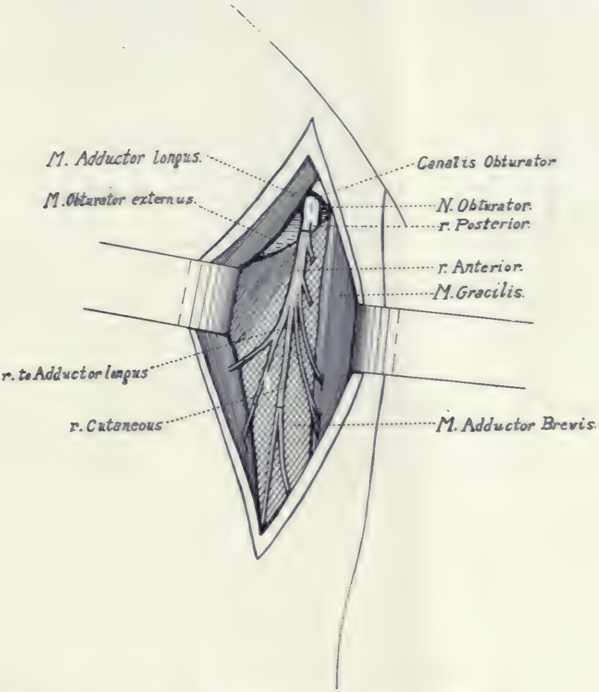

Fig. 281.—Exposure of N. obturator (semidiagrammatic). The M. M. adductor longus and pectineus are retracted laterally. Stippled portion represents the section removed at operation.

ment. Light massage, electric stimulation, and muscle training are carried on with this aim in view, great care being observed to avoid overstimulation or fatigue. Correction of deformity and protection of the overstretched muscles are maintained by light, easily removed splints.

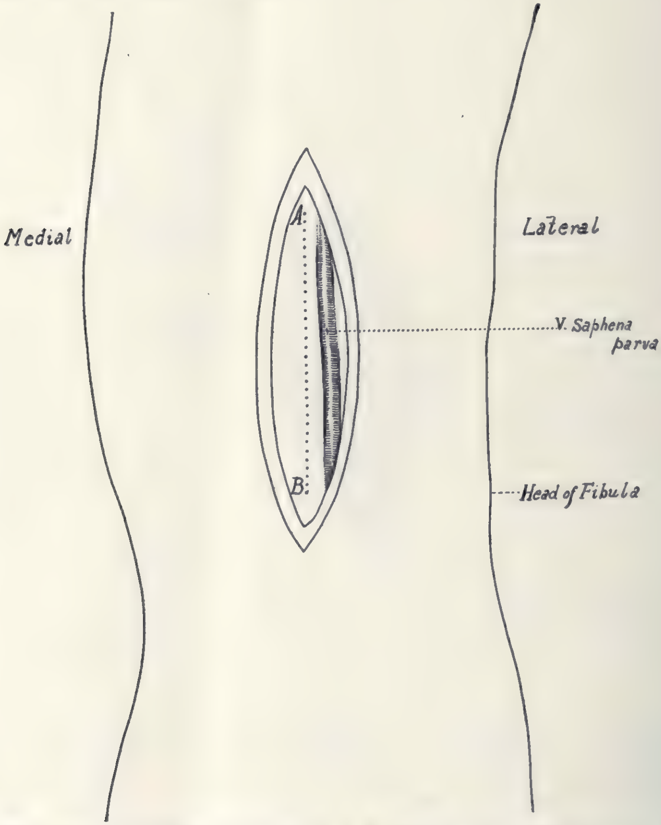

Fig. 282.—Skin incision for exposure of N. tibial at popliteal fossa. A–B, Line of incision in popliteal fascia.

Poor or unsatisfactory results may be credited to:

1. Type of patient—low mentality, marked athetosis, diffuse spasm, progressive disease.

2. Operative—technic and failure to properly estimate the quantitative factors.

The operation as applied to treatment of congenital cases has been well covered by Stoffel, Bundschuh, Bucholz, Gill, *et al.* The following case is cited as illustrative of its application to spasticity in adults due to causes other than congenital.

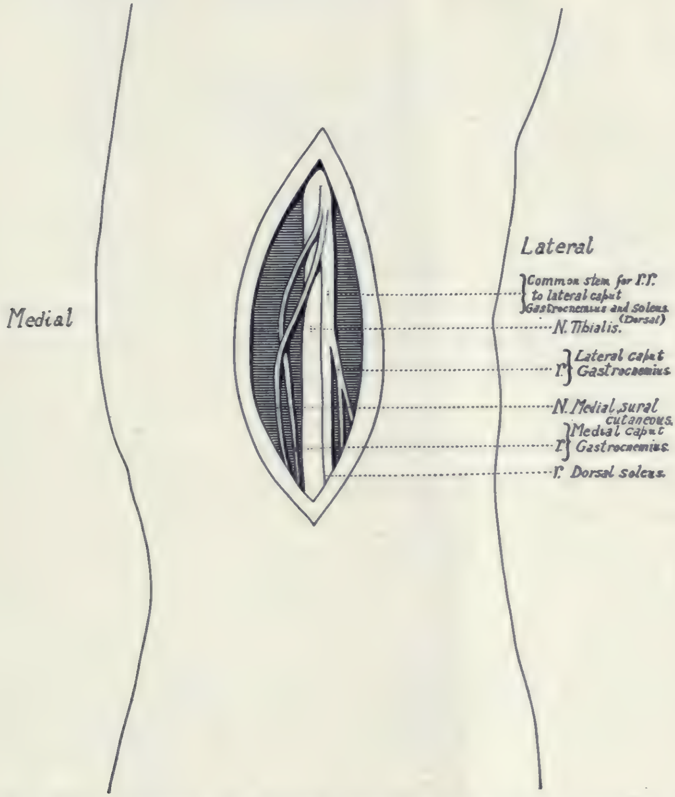
Lateral
Medial
Common stem for r.r. to lateral caput Gastrocnemius and Soleus.
N. Tibialis. (Dorsal)
r. Lateral caput Gastrocnemius.
N. Medial sural cutaneous.
r. Medial caput Gastrocnemius.
r. Dorsal soleus.

Fig. 283.—Exposure of N. tibial (semidiagrammatic) at popliteal fossa. With common arrangement of rami to M. M. gastrocnemius and soleus (dorsal).

The patient, a male, aged twenty-nine, occupation sailor, came to the clinic complaining of stiffness of the right leg and difficulty in walking. His family history and past history were unimportant clinically. His present trouble dates back to ten years ago, when his back was fractured in the lower thoracic region by a fall into the cargo hold of a vessel. He thinks he did not lose consciousness, but was unable to stand and there was no feeling below the hips. He was treated in a Rotterdam hospital for eleven weeks by extension on a waterbed. Sensation began to return during the first week. After six weeks he could move the toes of both feet, and a plaster jacket was applied in the eleventh week. Subsequently the left leg improved rapidly and he gained practically complete control on that side. The right, however, showed very little improvement. In all, his early treatment seems to have covered a period of three or four years. Recently, he has held a position aboard ship as an assistant steward. The duties performed are chiefly those of a second cook, but falls are frequent, and even the moderate activity demanded by the work is very fatiguing. The outstanding feature in the physical examination was his gait. The right lower extremity was partially flexed at the hip, markedly adducted, and the foot was in equinovarus. Ankle-clonus was set up at each step and he was forced to swing the left leg around the adducted right leg. The spine showed a rounded kyphos in the region of the eleventh and twelfth thoracic vertebræ, and a sharp lordosis in the lumbar region. The *x*-ray diagnosis was "An old fracture of the twelfth thoracic and third lumbar vertebræ." The reflexes of the lower extremities were spastic in character. No sensory disturbances were noted. The neurologic consultant gave the following opinion: "Originally a hematomyelia with cord injury at the twelfth dorsal and first lumbar segments, probably. Prognosis: Permanent condition as exists at present. No treatment advised unless some peripheral means are indicated." The blood Wassermann was repeatedly negative. Operative indications in this case were to correct the adduction and equinovarus deformities by restoring power balance in the affected muscle group.

Operation, September 22, 1920: Under ether anesthesia the anterior ramus of the obturator nerve was divided 3 cm. from the obturator canal. The tibial nerve was exposed at the popliteal space and approximately two-thirds cross-section was resected from the funiculi to the gastrocnemius; the dorsal funiculus to the soleus completely resected; the funiculus to the tibialis posterior was resected to one-half cross-section. Surgical recovery uneventful.

At the end of a week a fair range of voluntary abduction of the thigh and dorsal flexion and abduction of the foot were possible. The patient was discharged from the hospital on the eighth day following operation, and nine days later secured a position in the hospital as ward attendant. The improvement in his gait was quite remarkable. Some time later he reported with a painful knee. Examination at this time brought up the question of correcting the hip flexion. Accordingly, he was returned to the ward, and operation performed on December 8th. The ileopsoas is not accessible to neurotomy. Therefore the fibers were raised from their insertion, through a posterior incision, splitting the gluteus maximus and quadratus femoris. Twelve days later the patient was discharged to the Out-patient Department, where he has been under observation at frequent intervals up to the present time. Active abduction is two-thirds normal in degree, adduction normal, flexion and extension free, but carried out rather stiffly. The position of the foot is normal. He is now able to walk a mile or more without fatigue, and has been employed as a fireman at one of the hospital buildings. He intends to return aboard ship as a seaman at the cessation of current labor troubles.

Conclusion.—Although this case does not represent an end-result, the immediate effect of the operations is favorable. The case illustrates the extremely short hospital convalescent period. It seems fair to infer that cases of this type offer a field for neurotomy.

Note.—A detailed clinical record of the above case has been accepted for publication by the Boston Medical and Surgical Journal.

CLINIC OF DR. JOHN HOMANS

PETER BENT BRIGHAM HOSPITAL

THE SYMPTOMATOLOGY OF CARCINOMA OF THE LARGE INTESTINE[1]

The Cecum; the Ascending Colon; the Transverse Colon; the Descending Colon; the Sigmoid Flexure; the Rectosigmoid Juncture; Summary; Illustrative Cases; Tables, etc.

THE present status of the treatment of malignant disease of the large bowel fairly represents on the one hand the failure, and on the other the real progress, of the medical profession in the fight against cancer. It is perhaps putting the matter too strongly to say that surgery has obtained an ascendency over any particular form of malignancy, but evidence is beginning to accumulate that surface carcinoma, as for instance, of the breast and cervix uteri, may be cured by operation in a proportion as high as 50 per cent. even in unselected series of large clinics. That any such figures, though only for accessible or visible cancer, are deceptive is well known to both general practitioner and surgeon, since many patients are seen for the first time by the former only when palliation alone is possible, or can only be persuaded to see the latter when a radical cure is equally hopeless. Nevertheless, through the education of the public, the general practitioner, and the surgeon, real progress in the treatment of surface growths is constantly being made, as contrasted with the apparent hopelessness of malignant disease inaccessible to external examination. Into this latter category fall cancers of the esophagus, the stomach, the intestine in general, and the prostate.

While it is true that in the case of the stomach malignancy superimposed on ulcer and discovered in operations performed for ulcer is quite curable, cancer well developed enough to be recognizable as such is rarely cured. In the same way cancer found by microscopic examination of an innocent appearing prostate may be cured, while outspoken cancer cannot. In other words, the concealed carcinoma, by the time it gives symptoms as a tumor, offers very little opportunity for curative removal. There is, however, reason to believe that in some directions better results are not only possible but probable, and I wish particularly to speak of cancer of the large intestine, leaving aside the rectum (a field theoretically more favorable). Dr. W. J. Mayo[1] is able to show that by increasing boldness and skill in attacking growths of the large bowel the percentage of patients cured has been notably increased even though the operative mortality as well has been raised. Further progress in this field is to be expected and may well be made not only by greater operative skill on the part of the surgeon, but even more perhaps by a more prompt interpretation of symptoms by patients and physicians.

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[1] From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston.

The results of an investigation in this clinic into the early symptoms of cancer of the colon have proved sufficiently striking to warrant the belief that though the symptoms of large intestine cancer may be well known to those having a large experience in this field, they are not being generally taught or published. More particularly has it been evident that the symptoms have a considerable variation in accordance with the portion of the large intestine invaded by the growth.

Sixty-one patients with cancer of the large intestine, exclusive of the rectum, have been treated on the Surgical Service at the Peter Bent Brigham Hospital from 1913 to 1920 inclusive. Operations have been performed upon all but 2. In grouping these cases it is apparent that cancer has occurred most often in the sigmoid, and that the transverse colon and cecum are the next favorite locations. Beginning at the upper end of the colon, there were found: Tumors of the cecum, 11 cases; of the ascending colon, 6; of the transverse colon, 12; of the descending colon, 6; of the sigmoid loop, 13; and of the recto-sigmoid, 13. From the beginning to the end of the large bowel there is a wide variation in the symptoms, but individual cases in each group are more or less alike. Thus, there is a gradual transition from the appendix-like complex of the cecum to the almost pure obstruction complex of the sigmoid, but the symptoms of cancer of the cecum and of the sigmoid are in each case quite consistent. It appears also that there is a very considerable range of time in the duration of symptoms before the patients seek relief, and in certain parts of the intestine there exists a rather surprising relation between the duration of symptoms and the operability of the growth.

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[1] Mayo, William J.: Mortality and End-results in Surgery, Surg., Gynec., and Obstet., 1921, xxxii, 97 (February).

THE CECUM

Let us remember that in this portion of the large intestine the feces are liquid, and perhaps for this reason obstruction is rare. In general, the symptoms resemble those of recurring or subacute appendicitis. Among 11 patients, only 1 suffered from obstruction due directly to the tumor itself. In 3 others the small intestines were obstructed by extensions of the growths outside the cecum, a late result calling attention to an inoperable condition. Whether or not an inflammatory reaction accompanying the growth rather than the direct effect of the tumor itself has been responsible for this tendency, it appears that 4 of the 11 patients suffered from attacks of acute or subacute right-sided pain, and that another showed typical indigestion suggestive of chronic appendicitis or duodenal ulcer. Five others complained of *attacks* of cramp-like abdominal pain at or below the umbilicus. One suffered merely from indigestion and diarrhea. The average duration of symptoms before the patients sought relief was six to seven months—in the majority about four months, and yet only 3 cases were subjected to, or were held to be subjects for, intestinal resection.

While this is discouraging from an operative standpoint, a résumé of several histories shows that operation might have been performed much earlier had a little more attention been paid to the patient's early complaints, and again, several operations performed for what was thought to be, or what actually was, acute appendicitis failed to discover the carcinoma which was at the bottom of the trouble.

As an illustration of failure to secure an early operation the following history will serve:

Case I.—J. H., female, age sixty-three years, Surg. No. 6501. Nine months before entrance the patient experienced an attack of epigastric distress with nausea, followed by severe griping abdominal pain. During the next week there was localized soreness in the right iliac fossa. She did not go to bed, but saw a physician, who told her that she had "strained her side," and advised painting with iodin. She suffered a similar attack four months later, and was then told that she had gall-bladder disease. Following the second attack soreness with exacerbations in the right lower quadrant persisted. Finally, she was told that she had appendicitis or a tumor, and nine months after the initial symptoms entered the hospital. At this time a "cake" was felt in the appendix region, but on account of the patient's age and apparent cachexia cancer was suspected. At operation the growth was found to have perforated the cecal wall, involving the omentum and the neighboring parietal peritoneum. Even now a wide excision was performed, but the patient died eight months later without intestinal symptoms.

The next case offers an illustration of the failure of a *patient* to call a physician's attention to a tumor:

Case II.—E. P., female, age forty-three years, Surg. No. 3583. Previous history unimportant except for attacks of "inflammation of the bowels" thirty years before, occurring through two years. Four months before entrance the patient began to have severe pain in the right lower quadrant. The pain was cramp-like, nauseating, came at odd times, and was occasionally accompanied by chilly and feverish sensations. Her natural constipation was somewhat increased. She steadily lost strength and ambition, but did not go to bed or call a physician until just before entering the hospital. Appendix abscess was diagnosed.

At operation a colloid cancer involving the posterior cecal wall and the appendix was found. At a second operation soon after the first an ileosigmoidostomy was performed. The patient died six months later.

A third case illustrates one of several instances in which a surgeon failed to find a cancer of the cecum even with the abdomen opened:

Case III.—W. J. W. W., male, age sixty-two years, Surg. Nos. 5494 and 7307. The patient first noted a sore spot in the right lower quadrant on bending over. Two days later he began to feel chilly and feverish; suffered sharp knife-like pains in the right lower quadrant, and became tender to touch in this region. This attack lasted a week. One year later he had a similar illness. The attack which brought him to the hospital followed a month after the second. He had then lost 6 pounds during the year. Moderate tenderness was found over the cecum and in the lumbar region, signs noted as being very slight considering the character of the recent symptoms.

At operation a mass suggestive of cancer was found behind the cecum. The appendix was not seen. On the insufficient evidence that no cancer was found on immediate microscopic examination of several adjacent lymph-glands, the wound was drained and nothing further was done. After leaving the hospital he continued during the next year to suffer from local soreness and pain. On his return he was again explored, and was found to have a retrocecal abscess accompanying inoperable colloid cancer of the cecum. He died two years later without symptoms of obstruction.

TABLE I

Carcinoma of the Cecum. (11 Cases.)

Simulating appendicitis (4):
- E. P. (II). Duration, four months. Inoperable.
- W. J. W. W. (III). Duration, thirteen months. Disease not found at first operation. Later inoperable.
- J. H. (I). Duration, nine months. Operable. Died of recurrence.
- P. C. V. Duration, six months. Appendicitis with abscess. No evidence of cancer at first operation. Later inoperable.

Simulating reflex appendix symptoms or ulcer (1):
- G. P. Duration, eighteen months. Previous appendicectomy had failed to find the tumor. Later inoperable.

Diarrhea and indigestion (1):
- A. J. Duration, three months. Inoperable.

Cramp-like abdominal pain (5):
- W. E. C. Duration, three months. Operable. Well fourteen months later.
- L. G. Duration, five months. Operable(?). Involvement of adjacent small bowel causing obstruction. Operation failed to find lesion. Death from perforation.
- C. A. H. Duration, four months. Inoperable.
- H. L. F. Duration, four months. Inoperable.
- D. H. Duration, two months. Inoperable.

To summarize: Cancer of the cecum simulates appendicitis or manifests itself in *attacks* of abdominal cramps. Intestinal obstruction is rare, but may occur late in the disease owing to the growth of the tumor into surrounding regions. The disease is usually advanced when the patient seeks relief. In this series patients presented themselves on an average of six to seven months after the onset of symptoms, 3 only could be considered subjects for radical resection, and 1 only is alive fourteen months after such an operation. The operability would have been considerably increased had attention been paid to recurrent symptoms simulating appendicitis in persons within the familiar cancer age, and if operators had sea ched more carefully for cancer in several patients operated upon under a mistaken diagnosis.

THE ASCENDING COLON

Possibly this portion of the bowel, whose range is somewhat arbitrary, should be considered with the cecum, yet here the course of the disease is quite different. I shall consider that the ascending colon begins $2\frac{1}{2}$ inches beyond the tip of the cecum and extends through the hepatic flexure.

Since the feces are again liquid, complete obstruction, as in the cecum, is unusual. One rather complete obstruction only was admitted and operated upon successfully. Of the 6 cases in this series, only 1 imitated appendicitis. As a rule, a tumor of the right side of the abdomen, represented either by the growth itself or by moderate gaseous distention of the cecum, was present, a partial obstruction encouraging fermentation and putrefaction behind it.[1] But the most noteworthy characteristic of these tumors has been the remarkably late date at which patients have come to operation and the high operability and curability of the cancer; for of the 6 cases with an average duration of symptoms of over two years, 3 were subjected to radical operation, and all 3 are alive two to three years later.

Several cases are worthy of description. The first, which on superficial study simulated appendicitis, should have been regarded as suggestive of cancer:

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[1] It is quite probable that tumors in this region interfere with the reversed peristalsis of the ascending colon. In this way the churning of the liquid bowel contents and the consequent absorption of its fluid is prevented, an encouragement to stasis and putrefaction.

Case IV.—T. W. E., male, age thirty years, Surg. No. 8017. For two and a half years the patient had attacks of dull aching pain in the right iliac fossa, accompanied by local soreness, and occasionally by nausea and vomiting. Movements frequently watery. Blood was noted at times in the movements, and after such discharge the patient felt relieved. Two years before admission the appendix was removed without demonstration of the tumor, but the patient was improved for only a few weeks (presumably through care of the bowels while in hospital). A most significant symptom was a feeling of "filling up" in the right iliac fossa, a sensation sometimes relieved by manual pressure. He entered the hospital complaining of pain in the right iliac fossa, nausea, and vomiting. *x*-Ray showed a filling defect close to the hepatic flexure in the ascending colon. Operation demonstrated a cancer at the point indicated in the *x*-ray, with involvement of adjacent lymph-glands, but resection was satisfactorily performed, and two years later, when last heard from, the patient was well.

Three other patients suffered from right-sided tumor, which in two instances represented the growth itself. In the third the actual cancer caused intermittent distention of the cecum, but was not actually palpable. This case will be described.

Case V.—A. E. W., female, age sixty years, Surg. No. 13,306, was ill for three years, steadily losing strength and weight. She suffered from moderate pain in the right iliac fossa, accompanied by local tenderness, and a mass, varying in size, but decreasing with a gurgling sound on manipulation, had been felt here for a long time. Attacks of diarrhea increased gradually in severity. Blood was frequently noted in the stools. The patient had been seen by many physicians and the mass thought to be an enlarged kidney! A barium enema demonstrated obstruction in the ascending colon. The patient was much emaciated and ill. On the ground that at this time the cancer was almost certainly incurable, operation, which was not desired by the patient, was not urged.

One may say, then, that cancer of the ascending colon gives right-sided symptoms, usually but not always of partial chronic obstruction, that a tumor is frequently present; that the disease is particularly insidious in origin, slow in its course, and even when seen late may be both operable and curable.

TABLE II

THE ASCENDING COLON. (6 CASES.)

Simulating appendicitis with cecal distention:
  T. W. E. (IV). Duration, two and a half years. Operable. Living, two years.
Tumor of right side emptying on pressure:
  A. E. W. (V). Duration, three years. Inoperable.
Tumor of right side without abdominal pain or cramps (cancer palpable):
  C. L. M. Duration, one year. Operable. Living, two years.
  A. B. W. Duration, eight months. Inoperable. Liver metastasis.
Anemia; right-sided gas-pains, but no obstruction:
  E. G. M. Duration, five years. Inoperable.
Obstruction:
  A. R. Duration, six months. Operable. Living, three years.

THE TRANSVERSE COLON

In this portion of the bowel there begins to appear a transition between the right-sided symptoms, with or without partial obstruction, characteristic of the cecum and ascending colon, and the truly obstructive symptoms of the bowel beyond. This change represents, perhaps, the effect of solidification of the feces.

Of the 12 patients having cancer of the transverse colon, 7 presented very decided symptoms of obstruction at the time of entrance to the clinic. As a usual thing several attacks resembling the final one, but relieved by cathartics, preceded it. The attacks were almost invariably characterized by severe abdominal cramps about the umbilicus or lower abdomen, and not on the right, as in cancer of the ascending colon. Vomiting was common, almost invariable, and moderate distention was the rule. While the histories have a definite family resemblance, they vary from a type in which constipation predominates to that in which attacks come rather out of a clear sky. The following cases illustrate, respectively, the two types:

Case VI.—D. J. St., male, age fifty-six years, Surg. No. 6748, entered complaining of "pain in abdomen." For one year there had been increasing constipation. Six weeks before entrance sudden abdominal cramps, most severe in the epigastrium, later lower down; no movements for three days with the first attack. Other attacks followed the first, and stronger cathartics were continually required. Complete obstruction with distention was established several days before entrance to the hospital. Loss of 10 pounds. Distention; visible small intestine peristalsis. A barium enema demonstrated obstruction in the transverse colon near the hepatic flexure.

At operation a very much contracted scirrhous cancer was found, and an immediate resection of the cecum, ascending and part of the transverse colon was performed. But though no metastasis was noted at operation, cancer soon recurred and overgrew the entire field.

Case VII.—D. J. S., male, age fifty-two years, Surg. No. 8267, entered the clinic complaining of "pain in the abdomen, with distention." Six months before he experienced an attack of generalized abdominal colic with vomiting. The bowels failed to move until started by cathartics, when diarrhea resulted. One similar attack previous to the most recent. For one week before entrance generalized colic and vomiting. No movements for three days during this period. Strong cathartics were followed as before by diarrhea. Loss of 20 pounds in weight.

Operation was made in two stages: preliminary cecostomy followed by resection of an adenocarcinoma of the transverse colon without evident metastasis. The result has been complete relief of three years' duration continuing to date.

Such symptoms are characteristic of the majority of transverse colon cancers. It is perhaps remarkable that one patient, a girl of twenty-three, came to the hospital within eleven days of the onset of her symptoms which suggested a left-sided lesion and more particularly diverticulitis. Though a barium enema gave notice of a suspicious defect in the region of the splenic flexure, exploration was not accepted, and when the patient returned some months later there was found, in fact, an abscess connected with an adenocarcinoma in this region. Resection was followed by fatal recurrence.

Two other cases are exceptional, the first because a palpable tumor was found without symptoms of obstruction (as in several ascending colon tumors), the second, because diarrhea was the only complaint.

Five of the 12 cases were subjected to radical operation, though judging from the duration of symptoms in some of them —five years, in one instance—it is extraordinary that the tumor should have remained so local. Two of the 5 patients died later of recurrence, and the other 3 are alive, respectively, one, three, and three years after operation. This is not a very good showing in view especially of the long time which must elapse before recurrence can be considered as out of the question.

To summarize: The majority of transverse colon cancers cause symptoms of obstruction. Abdominal colics are the rule, the pain is usually general, almost never right sided, and the symptoms are apt to appear in attacks. The duration of the disease (at least in this series) is extremely variable, and, on the whole, it seems hard to believe that in the face of such pronounced symptoms many of these patients can suffer so long before consulting a surgeon. Great progress is therefore likely to be made through earlier diagnosis.

TABLE III

The Transverse Colon. (12 Cases.)

Obstruction symptoms. Attacks of cramps (7):
- C. McK. Duration, four months. Inoperable.
- D. J. S. (VII). Duration, six months. Operable. Living, three years.
- J. R. Duration, one year. Inoperable.
- S. W. D. Duration, five years. Operable. Living, one year.
- D. J. St. (VI). Duration, one year. Operable. Died of recurrence in six months.
- J. S. Duration, five months. Inoperable.
- D. R. H. Duration, three months. Inoperable.

Epigastric or general abdominal pain (3):
- M. E. Duration, six years. Operable. Living, three years.
- M. A. P. Duration, six months. Operable. Died of recurrence in fourteen months.
- J. C. Duration, five months. Inoperable.

Palpable tumor (1):
- C. H. C. Duration, eleven months. Inoperable.

Diarrhea (1):
- J. R. Duration, two years. Inoperable.

THE DESCENDING COLON

We are now dealing with that portion of the large intestine in which the feces, having lost their fluid, are temporarily stored or passed on to the sigmoid for evacuation. Obstruction in this region will, therefore, have much the same effect as in the sigmoid. It appears, however, from a study of the 6 cases in this series that in 3 instances the symptoms of obstruction occurred in attacks rather than as an insidious steadily increasing constipation. Indeed, one of these 3 complained of no more constipation between attacks than had been present in the past. Of the patients who did not suffer from attacks of obstruction at intervals, 2 were increasingly constipated during the course of the disease, and ended by showing the distended abdomen of full obstruction with its familiar concomitant symptoms. But even among the patients suffering from intermittent stoppage there was evidence that the beginning of the large intestine had become increasingly distended and that the pain symptoms arose from difficulty in emptying the small intestine into it. This is consistent with the distribution of the pain, which was almost invariably a general colic, not right-sided, and felt with greatest intensity in the lower abdomen.

The duration of symptoms was, as might be expected, long in those patients who suffered from the more intermittent obstruction and short (about six months) in the steadily increasing type. The following histories illustrate respectively the two general varieties:

Case VIII.—H. B., male, age forty years, Surg. No. 4080. Three years before entrance he had experienced a sudden stoppage of the bowels, with general abdominal colic, distention, and vomiting. He was under treatment for two months and recovered. From that time and until nine days before admission to the hospital he had had no further trouble. At this time his bowels failed to move and from then on he had eaten nothing, but had not vomited. An enema given on entering the hospital released quantities of gas which soon reaccumulated. An *x*-ray without barium enema showed ascending, transverse, and upper part of the descending colon to be distended with gas (Fig. 292). Barium enema demonstrated an obstruction in the descending colon.

Operation in three stages, with resection of the descending colon, was followed by recovery. The lymph-glands were not involved. Five years later, at the present date, he is well. Undoubtedly the first attack was due to the cancer, an illustration of the slow growth of the tumor and its tendency to remain local.

Case IX.—F. G. D., male, age fifty-five years, Surg. Nos. 11,153 and 11,573. For six months, constipation accompanied by colicky attacks of general abdominal pain increasing in frequency and severity. Vomiting sometimes accompanied and diarrhea followed the attacks. On entering the hospital barium was given by mouth, but merely showed a dilated lower ileum, and by its delay in the small intestine interfered seriously with the observation of the barium given later by enema. The position of the tumor in the large intestine could not be made out.

Operation in three stages for carcinoma of the descending colon; resection of this portion from splenic flexure to sigmoid. A year and a half later the patient remains well.

These two extreme types of history approach each other in the other instances. Both illustrate the backing up of the distention into the small intestine. In both the type of pain is the same. Evidently we must not expect to obtain localizing symptoms in these patients as in tumors of the right side of the colon. One case in the series is the exception which proves the rule. This patient suffered for a year and a half from attacks of high right-sided colic *without* obstruction, the only instance of this kind among the cancers of the transverse and descending colon. It would seem, then, that only partial obstruction causes right-sided large intestine colic; or, looked at another way, growths give rise to right-sided pain which cause incomplete obstruction in the beginning of the large intestine where feces are liquid, and rarely in any other portion.

To summarize: Cancer of the descending colon gives rise to symptoms of obstruction. Intermittence of symptoms is still fairly common. Colic is general in distribution. The growths metastasize late and both operability and curability are high.

TABLE IV

THE DESCENDING COLON. (6 CASES.)

Obstruction in attacks (3):
- H. B. (VIII). Duration, three years. Operable. Living, five years.
- M. L. E. Duration, one year. Operable. Living, three years.
- R. E. DeW. Duration, fourteen months. Inoperable.

Obstruction steadily increasing (2):
- F. G. D. (IX). Duration, six months. Operable. Living, sixteen months.
- S. N. P. Duration, seven months. Operable. Died of recurrence in one year.

Attacks of colic without constipation or obstruction (1):
- H. G. Duration, eighteen months. Inoperable.

THE SIGMOID FLEXURE

The portion of the bowel indicated under this head is the sigmoid loop as far as the rectosigmoid juncture. Here the classic picture of cancerous intestinal obstruction is seen. Of 13 cases, constipation steadily increasing to complete obstipation occurred in 9. Three others suffered from attacks of colic variously situated, but constipation, though evident, was not a prominent symptom. The last had bled from the rectum for some months before intussusception, due to the drag of the tumor, brought on by acute obstruction.

The large majority of the patients entered the hospital distended and vomiting, yet their symptoms had usually been of rather brief duration. This does not indicate that the tumors are necessarily of rapid growth, but rather that here fecal material may for a long time be forced through a partial obstruction, or that an accumulation of feces in the lower large intestine is tolerated for long periods without disturbing symptoms. Indeed, the early disturbances noted by these patients are merely exaggerations of familiar conditions or discomforts. Increasing constipation with occasional gripes or diarrhea (due to putrefaction) does not seem to be alarming to patients or physicians, and it is actually not until complete stoppage has been established for some days that relief is sought.

Such patients as have suffered for even three, four, or in one instance in this series eight years from mildly obstructive symptoms demonstrate that when not completely obstructing a cancer may remain local for an extraordinary period. Several of these cases have been re-explored on the supposition that the diagnosis previously made must have been wrong, yet here, as in many of the patients with a short history, the condition has been held to be inoperable.

Judging by the experience of the Mayo Clinic, we have been perhaps misled by local inflammatory reactions into believing the cancer more extensive than it actually was, and yet several otherwise apparently operable cases were found to have liver metastasis, while in one instance tissues removed from the point of union of the tumor with the sacrum showed cancer spreading through the periosteum. However we may have misread the indications for extirpation, the fact remains that cancer of the sigmoid usually shows itself convincingly at a late and often hopeless stage, and this in spite of the fact that it is habitually slow in growth. Of the 13 cases in this series, only 4 were considered suitable for resection, though all but one were explored. These 4 had had symptoms for three, four, six, and eight months respectively, and yet others whose symptoms dated back one week, three weeks, ten weeks, and five months were held, on exploration, to be hopeless.

I may perhaps illustrate what I have just said by one or two histories. The first represents the type in which the disease is found far advanced after only a few weeks of trouble.

Case X.—D. T. B., male, age seventy-one years, Surg. No. 7317. Ten weeks before entrance the patient began to feel tired and to lose his appetite. One week later he became constipated. Cathartics were effectual. He was told that he had "walking typhoid." On a special diet his bowels began to move better. He passed many small hard movements daily. Occasional vague colic. In the hospital, because of a low septic temperature and a tender mass in the pelvis, he was thought to have tuberculous peritonitis, diverticulitis, or cancer. He was much emaciated. Exploration showed obstruction in the sigmoid and matting together of the small intestines about the growth. Gray nodules of cancer on the surface of the adjacent bowel were found. He was held to be incurable and a sigmoidostomy was made. He died in the hospital two months later without improvement or opportunity for further surgery.

Here the growth was far advanced and the patient began to deteriorate *before* any characteristic symptoms were evident. Indeed, it seems to be a matter of luck that certain persons suffering from cancer of the sigmoid develop obstruction at an early and clearly operative stage. Though the result in the 2 following cases is likely to be excellent, neither patient nor physician can be complimented upon the successful outcome.

Case XI.—L. L. R., female, age forty-six years, Surg. No. 11,837. The patient's bowels had always been regular up to the onset of her illness! Six months previously she had begun to notice constipation, which steadily increased in degree, but up to ten days before entrance had been relieved by cathartics. From that time on there had been griping colic in the lower abdomen and peristalsis visible to the patient. A small bowel movement five days before entrance; none since. Vomiting occasionally. An *x*-ray taken previous to admission showed obstruction in the midsigmoid. On examination, distention of the sigmoid loop and the large intestine above it was obvious. Resection of the sigmoid in two stages gave complete relief, and now, one and one-half years later, the patient remains well.

Case XII.—G. L., male, age fifty-three years, Surg. No. 12,753, always well previous to this illness. Eight months before entrance he noted blood in his bowel movements and lost his appetite. He was treated, without examination, for hemorrhoids, which he did not have; lost 25 pounds; no constipation. Two weeks before entrance cramps in the lower abdomen were relieved by and followed by diarrhea. A second attack a week later was followed by pelvic distention. There was free blood in the bowel movements. A mass was felt on rectal examination, which at operation proved to be due to an intussusception of the sigmoid caused by the drag of a pedunculated adenocarcinoma. Resection in three stages was successful. A year later the patient is well and should remain so.

The second, of course, is an atypical case, but points the same moral as the first: investigation of abnormal intestinal conditions should be made, and made early.

TABLE V

THE SIGMOID FLEXURE. (13 CASES.)

Steadily increasing constipation ending in obstruction (9):
- R. H. A. Duration, five months. Inoperable.
- D. T. B. (X). Duration, two and a half months. Inoperable.
- W. H. C. Duration, one week. Inoperable.
- L. A. S. Duration, three weeks. Operable. (Refused after enterostomy.)
- W. H. Duration, eight years. Inoperable.
- E. C. Duration, four months. Operable. Living, one and a half years.
- A. Y. Duration, three years. Inoperable. Operation elsewhere. Recurrence.
- L. L. R. (XI). Duration, six months. Operable. Living, one and a half years.
- O. A. B. Duration, four years. Inoperable.

Griping pain or discomfort (3):
- M. L. Duration, eighteen months. Inoperable.
- R. S. Duration, twelve months. Inoperable.
- M. T. McC. Duration, three months. Inoperable.

Bleeding, deterioration, followed by attacks of obstruction (1):
- G. L. (XII). Duration, eight months. Operable. Living, one year.

To summarize: Of 13 cases of cancer in the sigmoid loop, the large majority present the classic picture of constipation ending in obstruction. The evidence is to the effect that the tumors are of slow growth, bringing patients to the surgeon at a late stage in their course, though often fairly soon after symptoms have become evident. Progress is more likely to be made by increased boldness in operating than by securing earlier opportunity to operate, for the symptoms are not such as to lead to much hope of early surgery, and inflammatory reactions about the tumor imitating extension of the cancer doubtless allow (as demonstrated by Dr. W. J. Mayo[1]) more radical and successful operations than have generally been performed.

THE RECTOSIGMOID JUNCTURE

These growths ought perhaps to be regarded as cancers of the rectum or, in some instances, of the sigmoid proper. As a class they naturally resemble cancers of the sigmoid, but they introduce a symptom rare in tumors higher up, observable by the patient and therefore important—the gross bleeding. They appear to be the most hopeless, from the point of view of operability, of any in the series. In this series of 13 patients, 1 only was definitely operable, while 2 others might well have been, but died after a preliminary colostomy. As the one operable case died as a result of resection, one can hardly imagine a worse showing. Curiously enough, no class of cancers comes so early, if one may judge by the symptoms, to operation. Only 4 patients had had knowledge of symptoms dating back more than six months, and 5 had suffered for two months or less. The tumors must then have a long latent period or they must be very rapidly growing. Judging by what we know of cancer of the large intestine in general, the former is perhaps more likely.

As to symptoms, constipation leading on to obstruction was present in 9, among whom 5 had had noticeable blood in the stools. Two others had had attacks of cramps ending in obstruction, but not accompanied by constipation between attacks, and two had suffered from diarrhea accompanied by bleeding. Evidently bleeding is a common and important symptom, and doubtless examination of the stools of those who noted no blood would have demonstrated it microscopically or chemically long before entrance to the hospital. It is hardly necessary to point out that all patients to whom blood was evident in the movements should have received at an early date the rectal examination which usually discloses the tumor, and should not have been treated on insufficient evidence, as is usually the case, as if suffering from hemorrhoids. Moreover, the 2 patients who experienced attacks of intermittent obstruction and whose stories date back a year each, either neglected their health or were slighted by their physicians.

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[1] Mayo, W. J.: *Loc. cit.*

There is, then, obviously room for improvement in the diagnosis of cancer in this vicinity, and this not because of the urgency of the symptoms, but rather because the presence of blood in the stools offers a clear indication for rectal examination, digital and proctoscopic, and for the use of the barium enema. The latter is quite likely to indicate obstruction even if the former discloses nothing, since, as the histories clearly show, most patients have definite obstruction symptoms.

Here I should like to say a word as to the use of the *x*-ray in diagnosing cancer of the large bowel. In this series it has been exceedingly effective if the enema is used and rather ineffective if barium is given by mouth. In one instance a barium enema failed to demonstrate a lateral cancer of the cecum (Fig. 286), and in another a clean bill of health was given a young woman whose symptoms strongly suggested a diverticulitis or cancer of the transverse colon. In the latter instance one examination suggested a defect in the bowel wall and a second failed to demonstrate it. It is undoubtedly the surgeon's (the writer's) fault that this discrepancy in observing early cancer was not allowed for. In several cases the roentgenologist reported that the patient could not retain the barium, but observed no definite obstruction. Here the failure to retain the barium was nearly as important as if a clean-cut defect had been seen.

As to barium by mouth, the story is quite different. In the first place, barium should not, of course, be given by mouth to patients suspected of obstruction, since it loads up the bowel, and even if it passes through, is likely to leave the lower small intestine filled for a considerable period, obscuring the view in examination by enema (Figs. 284, 287). In any case, therefore, enema should be given first. And, again, it is the fluoroscopic examination as the barium flows in, which most clearly demonstrates cancer in the large intestine, since a narrow tumor causing little obstruction may well fail to show in a plate. But there is one form of examination which is exceedingly valuable, simple, and requiring no injection whatever. This is the plate of the abdomen to show gas accumulation in the bowel. Excellent localizations have been made in persons with partial obstruction by showing gas-filled bowels above the tumor, and while no positive diagnosis can be made in this way, such evidence, especially in weak distended patients, is most helpful (Fig. 292). The *x*-ray may be said to be most important and, in expert hands, extremely accurate in diagnosing cancer of the large intestine. A positive diagnosis must, however, be regarded as more important than a negative examination.

TABLE VI

THE RECTOSIGMOID. (13 CASES.)

Constipation increasing to obstruction (4):
- E. C. K. Duration, six months. Inoperable (?). Died after preliminary operation; a second had been contemplated.
- M. E. R. Duration, one and a half months. Inoperable (?).
- F. W. A. R. T. Duration, two months. Operable. Died following operation.
- G. T. G. Duration, one month. Inoperable.

Constipation increasing to obstruction, with blood in stool (5):
- P. W. M. Duration, six months. Inoperable.
- G. T. W. Duration, three months. Inoperable.
- J. T. H. Duration, two years. Inoperable.
- A. B. Duration, two months. Inoperable.
- G. T. Duration, three weeks. Inoperable. Small tumor. Nodules in liver.

Abdominal cramps in attacks ending in obstruction (2):
- H. M. G. Duration, eleven months. Inoperable.
- A. E. D. Duration, twelve months. Inoperable.

Diarrhea with blood in stools (2):
- T. M. Duration, two years. Inoperable.
- J. M. W. Duration, six months. Inoperable.

SUMMARY

One hardly would dare to draw very strong conclusions from a study of this small series of cases, particularly as to the operability, operative mortality, or curability of cancer of the large bowel. Indeed, the operative indications and results are not at issue here except in so far as they relate to the nature and duration of symptoms. These symptoms possess, in any one part of the bowel, family resemblance with minor variations; as between distant parts, gross differences, shading into each other in the intermediate portions. The right side of the intestine, into which the liquid contents of the small intestine are emptied, responds in one way; the left side, containing dried and drying fecal matter, in another. This difference is perhaps intensified by the failure of tumors of the cecum and ascending colon to cause the scirrhous constrictions so often seen farther along. It is also quite possible that tumors of the right side of the colon interrupt the reversed peristalsis which occurs here. For the reversed peristalsis which begins in the proximal part of the transverse colon, passes back over the ascending colon and cecum, churning the liquid feces, and by forcing them into the interstices of the mucous membrane, is an important agent in removing their fluid. Interruption of this peristalsis by a tumor may conceivably, then, increase stagnation and fermentation. On the other hand, tumors in the transverse colon and beyond, though obstructing, do not necessarily interfere with the motility of the right side of the large intestine, which may gradually hypertrophy and distend without causing any symptoms until the distention is passed back to the lower small intestine.

Tumors of the cecum cause intermittent rather than steadily progressive symptoms which may simulate recurrent appendicitis or may show themselves as low abdominal colics. The symptoms, on the whole, come late in the development of the tumor. Patients seek relief earlier than in cancer of most other parts of the large intestine, but the operability is low. Since appendicitis is imitated and apparently in some instances initiated by the tumor, much is to be expected by earlier and more careful operating for recurrent or persistent symptoms of appendicitis in persons within the cancer age. Obstruction is not a symptom to be looked for.

Cancers of the ascending colon rarely cause the familiar obstructive symptoms. Right-sided tumor may develop without any obstruction or through visible filling of the cecum. Soreness, pain, or colic is right-sided. Development is slow and operability is high.

In the transverse colon obstruction is the rule, but progressive constipation is seldom seen. Intermittent attacks of general abdominal colic accompanied by constipation are the usual manifestations. A palpable tumor or even diarrhea may be the only complaint. The duration of symptoms is extraordinarily irregular and the growths metastasize late, giving a fairly high operability.

In the descending colon cancer manifests itself about as often by slowly increasing constipation as by intermittent obstructive attacks. The development of the growths is slow and operability is astonishingly high.

In the sigmoid is seen the classic picture of large intestine cancer. Gradual onset of obstruction through months or years of constipation is the rule. The symptoms calling for relief may often be of comparatively short duration, but tend to show themselves late in the development of the disease. The operability is low, but may well be raised by bolder operating.

Cancer in the rectosigmoid region resembles that in the sigmoid, with this important additional sign—gross bleeding. Symptoms are of short duration, and the disease is advanced before they have been long urgent, but improvement in treatment is to be expected both through earlier diagnosis and by more bold and skilful operating.

I have tried to point out the common rather than exceptional manifestations of cancer of the large bowel, to explain the variations, and to suggest how they may lead to better surgical treatment. By correcting obvious errors in our treatment of this series much might have been accomplished. The general practitioner, by taking better histories, by more thorough physical examinations, and by ceasing to wait for physical incapacitation before urging surgical relief, could have helped still more. And when all is said and done, if we are to *cure* internal cancer, we must act on suspicion and without full proof. We may at times explore an innocent abdomen, but we shall save more lives.

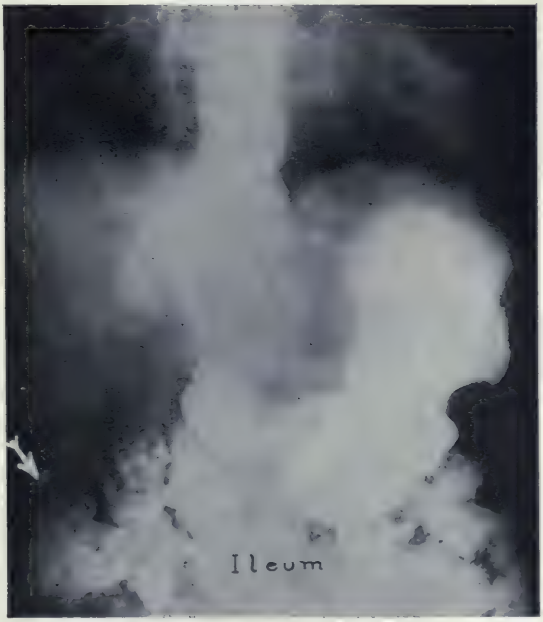

Fig. 284.—W. E. C. Cancer of cecum. Barium by mouth. Note dilated coils of ileum filled with barium mixture and gas. Arrow indicates region of tumor. Compare with Fig. 285.

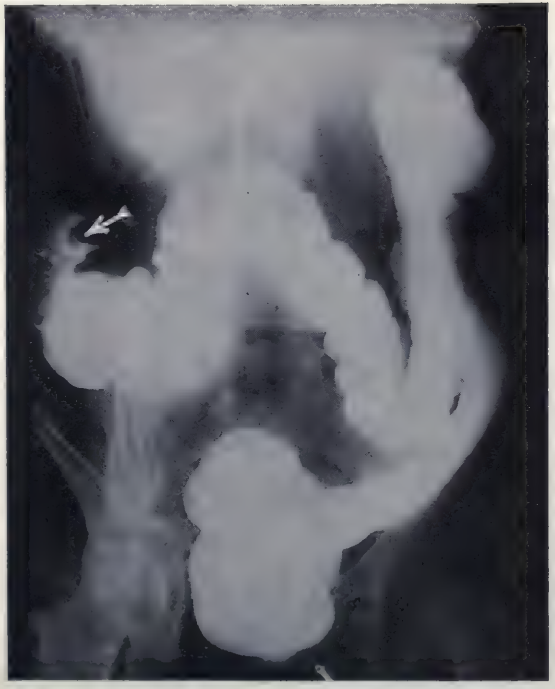

Fig. 285.—W. E. C. Cancer of cecum. Barium enema. Note filling defect in cecum. The ascending colon has a mesentery and hangs below the cecum. Compare with Fig. 284 (the same patient).

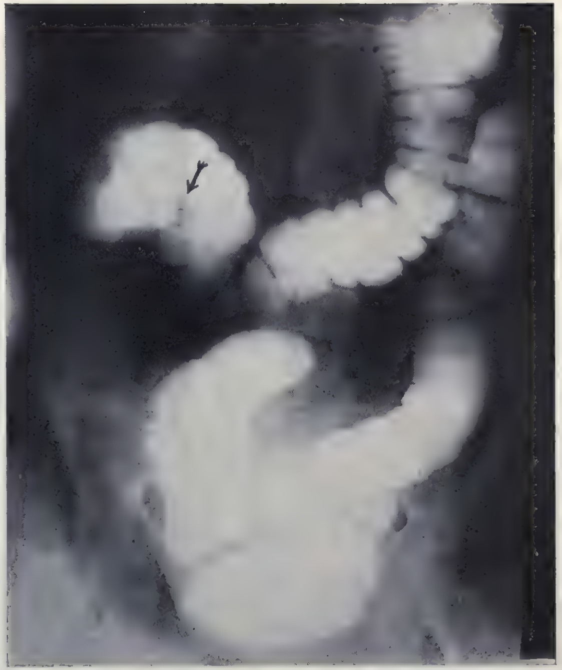

Fig. 286.—L. G. Cancer of cecum. Barium enema. Arrow points to small lateral defect in cecal wall. This was missed on the initial examination.

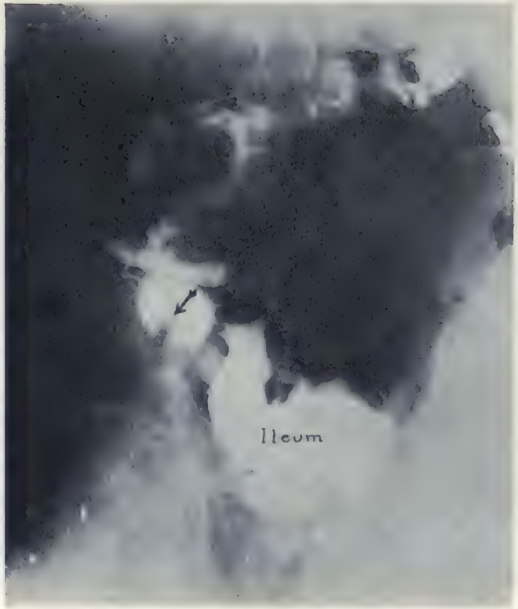

Fig. 287.—T. W. E. (Case IV.) Cancer of ascending colon. Barium by mouth. Note filling defect in what appears to be the cecum, and dilatation and accumulation of material in lower ileum. Compare with Fig. 288.

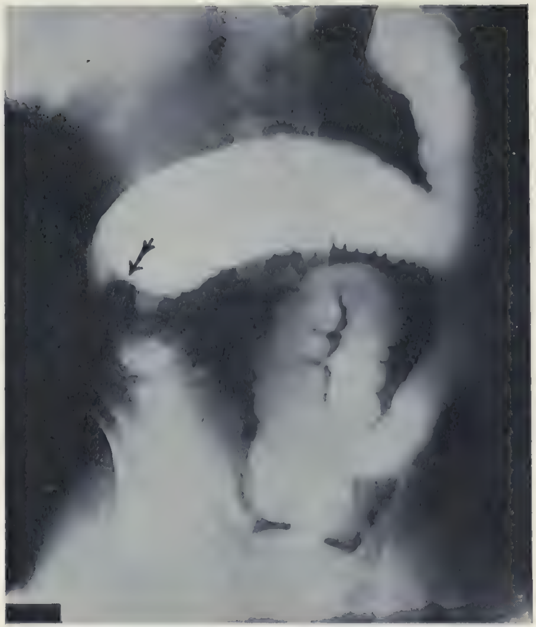

Fig. 288.—T. W. E. (Case IV.) Cancer of ascending colon. Barium enema. Note filling defect in ascending colon and small amount of barium in cecum below. Compare with Fig. 287.

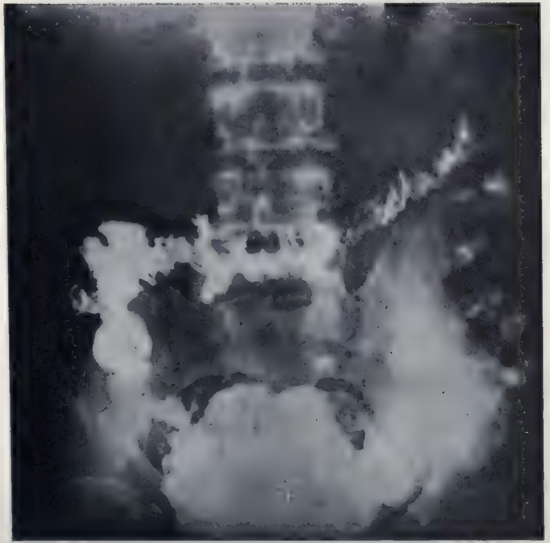

Fig. 289.—D. W. St. (Case VI.) Cancer of transverse colon. Barium by mouth. Note absence of obstruction in transverse colon. The ileum is dilated. Compare with Fig. 290.

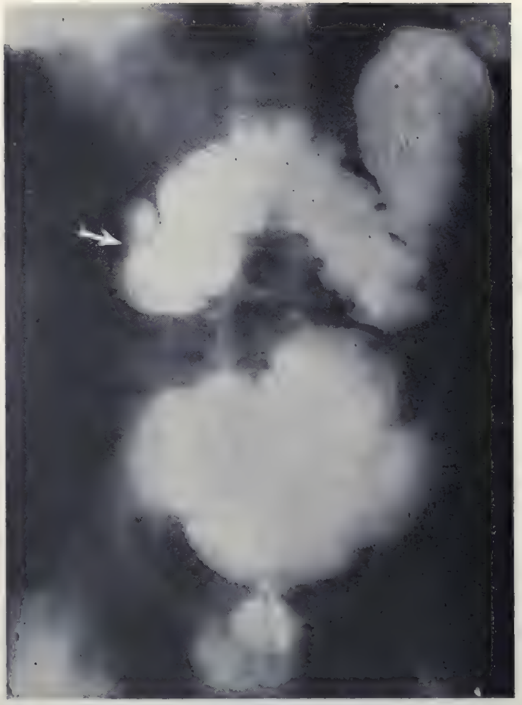

Fig. 290.—D. W. St. (Case VI.) Cancer of transverse colon. Barium enema. Note definite obstruction point as shown by enema. Compare with Fig. 289.

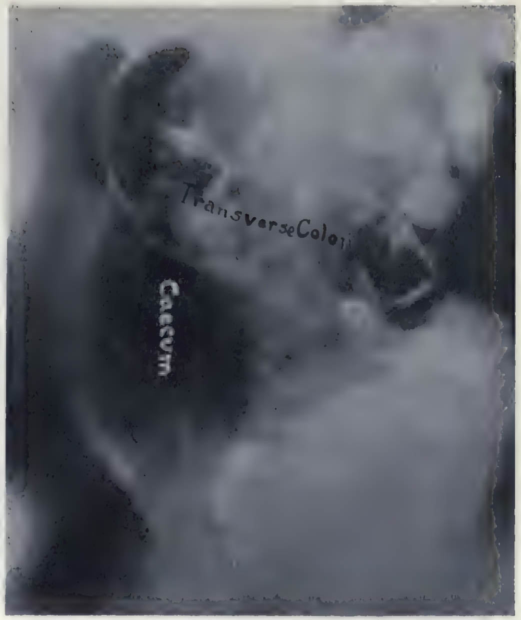

Fig. 291.—C. McK. Cancer of transverse colon. Barium enema. Note gaseous distention of cecum and transverse colon. The region of the growth is indicated by the meeting of the distended transverse colon with the contracted barium-filled bowel beyond.

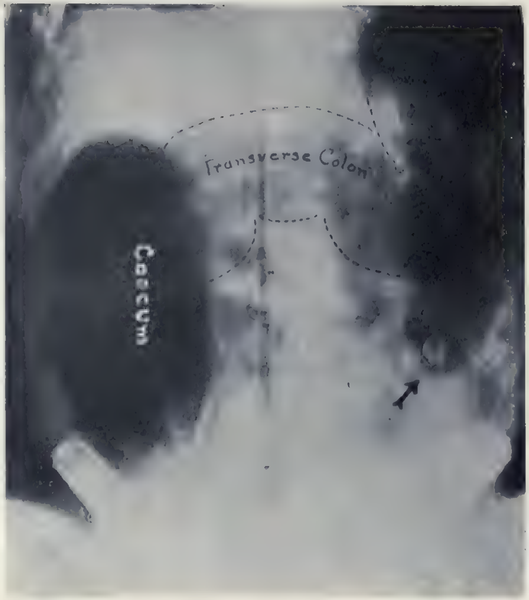

Fig. 292.—H. B. (Case VIII.) Cancer of descending colon. Plate of distended abdomen without introduction of barium mixture. The outlines of the transverse colon are emphasized by dotted lines. The tumor is at the distal end of the distended descending colon as indicated by arrow.

CONTRIBUTION BY DR. WYMAN WHITTEMORE

MASSACHUSETTS GENERAL HOSPITAL

LUNG ABSCESS

DURING the last few years at the Massachusetts General Hospital we have made an effort to differentiate between lung abscess and bronchiectasis before operation. In order to do this very close co-operation has been demanded and obtained between the medical man, surgeon, x-ray department, and laboratory. I believe the results of this work justify the statement that in the great majority of cases this differential diagnosis can be made previous to operation, and this is said in spite of the opinion which is occasionally expressed in literature that lung abscess, bronchiectasis, and gangrene are all one and the same process, merely differing in the extent and progress of the lesion.

It is essential that the surgeon be able to make his own diagnosis after weighing all the facts of the case. Although at the Massachusetts General Hospital and probably in all large general hospitals the majority of lung abscess cases are admitted on the medical service, where they are carefully worked up, yet the surgeon must be able to confirm or disagree with the diagnosis, as the ultimate responsibility for the life or death of the patient will be largely his. And as time goes on we find that more and more of these cases are admitted directly to the surgical service, where, it is my belief, they all belong.

Etiology.—The most common factor in our series of lung abscesses at the Massachusetts General Hospital has been the precedence of an operation on the upper respiratory tract under a general anesthetic. Out of 32 cases in which the etiology was definite, 17 were due to the removal of tonsils, 1 to the removal of adenoids only, and 3 to the extraction of teeth; this giving a total of 21 cases, or 65 per cent., due to this cause. I wish to lay great stress on this, and again bring to the attention of the general practititioner who does such operations, as well as of the specialist, the fact that there is a real danger of lung abscess, and what starts out to be a simple operation, at least in the layman's mind, ends as a most serious surgical condition, and in a certain number of cases as a terrible tragedy. Recently a strong healthy man of thirty-nine was examined and passed for life insurance, but was advised to have his tonsils removed. He consented to this and they were removed under ether; within a week he had an infection of the right lung and an abscess close to the hilum was soon demonstrated. I drained the abscess, and he did well for two weeks, and then gradually got worse, and died of septicemia five weeks after operation. Surely here what started out as a simple "safe" operation turned into a tragic catastrophe. A short time ago there were 5 lung abscess cases on the surgical service, all of which had been preceded by the removal of tonsils under a general anesthetic. Of course, the percentage of cases that develop abscesses following these operations is extremely small, but the specialists and those general practitioners who do these operations should realize that there is this danger, and they are the ones to do a little in "preventive medicine" by seeing that their patients are so operated on that this condition does not occur. Lord says, "In 25 of 100 cases, or 1 out of every 4, the cause may be definitely traced to operation about the upper respiratory tract. Pulmonary abscess followed operation about the mouth for cancer of jaw, lip, and tongue in 1 case each, the removal of tonsils or tonsils and adenoids in 12 cases, the incision of peritonsillar abscess in 1, and the removal of teeth in 9."

The next most common cause of lung abscess is bronchopneumonia, occasionally lobar pneumonia, but this is seldom the cause, contrary to the statements made in medical text-books. Septic infarct will be the cause in a certain small number of cases, this occurring in connection with pyemia, where a septic thrombus is set free in the venous circulation, for example, in septic puerperal thrombosis. Several years ago a young married woman entered the Massachusetts General Hospital with puerperal sepsis, and within forty-eight hours had symptoms of an infarct in the right upper lobe. An abscess of this lobe developed, and was operated on. She died six weeks after operation, and autopsy showed the lung abscess healed, but the left ovarian vein was a large abscess.

There are occasional cases caused by extension of, or perforation from, a septic process outside the lung; for example, from subdiaphragmatic abscess and suppuration in the mediastinum. Case 36, in this series, had a lung abscess that was caused by a septic process in the mediastinum breaking through into a bronchus, and at the same time or soon after it also broke through into the esophagus, so that after the lung abscess was drained, we found we were dealing with a broncho-esophageal fistula. Fortunately, this case entirely recovered.

Extension of infection or rupture from the pleural cavity into the lung undoubtedly gives rise to a breaking down of lung tissue and abscess formation in a small number of cases. Case 38 originally had an empyema that was drained, but recurred, and was neglected. He developed typical symptoms of lung abscess, with many very severe hemorrhages. The abscess was drained and he recovered completely. The diagnosis of empyema plus lung abscess, previous to operation, is difficult, and should not be confused with the rather common case of neglected empyema that perforates into a bronchus. Not infrequently cases are sent into the hospital diagnosed as lung abscess which prove to be empyemas that clear up rapidly when the pleural cavity is drained, and show no evidence of lung abscess.

Actinomycosis is an extremely rare cause, and during the last eight years we have had only 2 such cases at the Massachusetts General Hospital.

Age seems to have little bearing on the etiology except for the fact that in children under ten years of age abscess of the lung seldom occurs, and even up to twenty is rare. From twenty to forty is the most common period, but cases have occurred up to sixty-three years.

Situation.—It is the general belief that the majority of abscesses are situated in the lower lobe, and this would seem reasonable to suppose, especially in those cases due to aspiration, but this has been contrary to the findings in my series of cases. In 22 cases the abscess was in the upper lobe, and in 19 it was in the lower lobe. Louis Hamman says, "Aspiration abscesses, particularly postoperative, are more frequent in the upper lobe than the lower, about 2 to 1. Postpneumonic abscesses occur more frequently in the lower lobe than in the upper, about 2 to 1." It is an important fact that most abscesses are situated in the periphery of the lung. Of 30 cases coming to autopsy at the Massachusetts General Hospital, the lesions were in the periphery in 28. Another important fact from a surgical point of view is that in the majority of cases the visceral and parietal pleuræ are adherent near the site of the lesion. They may be firmly adherent or merely held by delicate adhesions. In 35 cases coming to autopsy at the Massachusetts General Hospital, the visceral and parietal pleuræ were adherent in one form or another in 30. This is very important from the operative point of view, as it would seem, and indeed it is true that in the majority of cases it will not be necessary to use any differential pressure anesthesia. But as there is no reliable means of knowing before operation whether or not the lung is free or adherent, it would seem wise to use or at least have at hand some form of positive pressure anesthesia when doing this operation.

Diagnosis.—The most common conditions that must be differentiated from lung abscess are localized bronchiectasis, encapsulated empyema, tuberculosis, and malignant disease that has broken down. It is my belief that this diagnosis can be made in most of the cases. This is based on four vitally important examinations: 1. History. 2. Sputum. 3. *x*-Ray. 4. Physical.

1. *History.*—Too much stress cannot be laid on careful, painstaking history, as the onset plays a very important part in making the correct diagnosis. Often the history is a difficult one to obtain, especially in hospital patients of foreign extraction, and particularly when the disease dates back three or four

months or even a year previous to entrance. Onset in lung abscess is an acute condition following within three or four days, to a week or ten days after a tonsillectomy, for example, starting with sudden pain in the chest, fever, and cough, and after a few days a sudden expectoration of a considerable amount of foul-tasting and smelling pus. On the other hand, a bronchiectasis is a gradual chronic condition; cough and fever, to be sure, but a gradual slow increase of expectoration. E. O. Otis says, in differentiating abscess from tuberculosis, that in the former there is "a fetid sputum which never occurs in tuberculosis, and there is generally some discoverable primary cause such as a previous operation or sepsis somewhere or an embolus." The spitting of blood is found in lung abscess, bronchiectasis, tuberculosis, and malignant disease, and so that in itself has no differential value in distinguishing between these conditions. Many abscess cases can rest comfortably lying on their backs or on the diseased side, but sudden turning on to their well side causes a paroxysm of coughing and the raising of a large amount of sputum. Primary malignant disease of the lung does not seem to be so rare as formerly supposed. It is possible to have cough, fever, and a blood-tinged pussy expectoration with cancer, and without a careful history, including age, as primary malignant disease of the lung only rarely appears before the 40's, cancer may easily be confused with abscess. A leukocytosis, if present, may be of value, but if absent is of no significance. Bronchiectasis, although no age is exempt, is rare in children. The onset is an insidious one, the patient in many cases knowing of no definite beginning. In others there may have been a slight infection of the respiratory tract, with cough and persistent sputum. The cough is worse during the winter months.

2. *Sputum Examination.*—In medical books too little emphasis has been laid on the great importance of the examination of the sputum. This is such an important examination, and so much knowledge may be gained from the study of the sputum, that no case is accepted for operation until the sputum has been examined not once, but several times, by the best expert that I

can find. Tuberculosis must be excluded, this requiring many examinations, and then a differential diagnosis made, so far as possible, between lung abscess and bronchiectasis. In abscess the sputum is purulent or mucopurulent, yellow, green or brownish in color, varying in amount from 2 to 20 or even 30 ounces in twenty-four hours. Although it may be odorless, yet in most cases it has a fetor that is very definite, but not as offensive as that found in gangrene or advanced bronchiectasis.

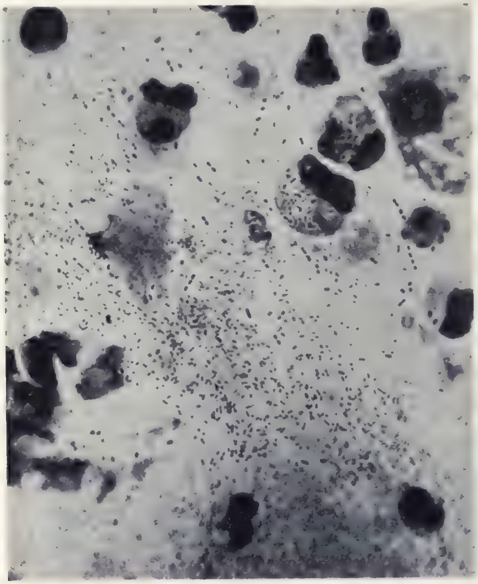

Fig. 293.—Sputum: Case of bronchiectasis. Influenza bacilli and pneumococci.

Pus from a single cavity tends to be homogeneous, with little mucus, whereas that from many small cavities is apt to be made up of small masses with considerable mucus; however, too much stress must not be placed on this. On standing, the sputum separates into three layers: mucus on top, saliva in the middle, and pus at the bottom. If elastic fibers are found, their presence points very strongly toward abscess. In my cases these have not been found in more than 4 cases out of each 10, but it may be that they would have been found more frequently if more time had been given to the search. Streptococci, pneumococci, staphylococci, and influenza bacilli are generally found and also appear in cases of bronchiectasis, but in cases of bronchiectasis the influenza bacillus, both intracellular and extracellular, is the predominating organism, whereas in abscess it is never the predominating organism. A most important observation has been made by W. H. Smith (which has not been published, but which he has been kind enough to allow me to mention). He states that he has never found hematoidin crystals present in the sputum except when pus has been found at operation, and the pus has always been a streptococcus pus. When only one kind of organism is found in the sputum (for example, pneumococci or streptococci), this points toward an empyema rather than an abscess, as in the latter there is always a mixture of organisms.

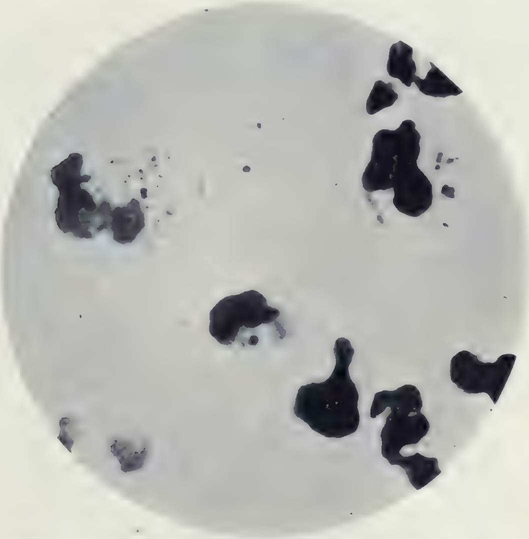

Fig. 294.—Sputum: Case of bronchiectasis. Influenza bacilli intracellular.

3. *x-Ray Examination.*—This is the most important examination, as it not only confirms or, indeed, makes the diagnosis, but also localizes very definitely the process, which is of the greatest value to the surgeon. Holmes and Ruggles say abscesses "assume the form of irregular areas of increased density which are most

marked at the center, fading out toward the periphery; when filled with fluid they are indistinguishable from the general shadow about them, but the large ones become very evident when filled with air, particularly if they contain sufficient fluid to cause a fluid level. They are seen as round areas of greatly diminished density, and, if a fluid level is present, its surface shifts according to the position of the patient. . . . The localization is often disappointing to the surgeon because of the zone of pneumonic infiltration about them which magnifies the area of involvement. . . . Bronchopneumonia may be differentiated by the fact that it gives a shadow of more uniform density and there is no cavity formation." In bronchiectasis there is "an extensive thickening of lung markings along the course of the large bronchi and enlargement of the hilus glands, with the presence of single or multiple areas of increased density in the lung fields near the bronchi—cavities are often to be demonstrated." In a number of my cases in which the lung and pleura were not adherent the *x*-ray has localized the process one or even two

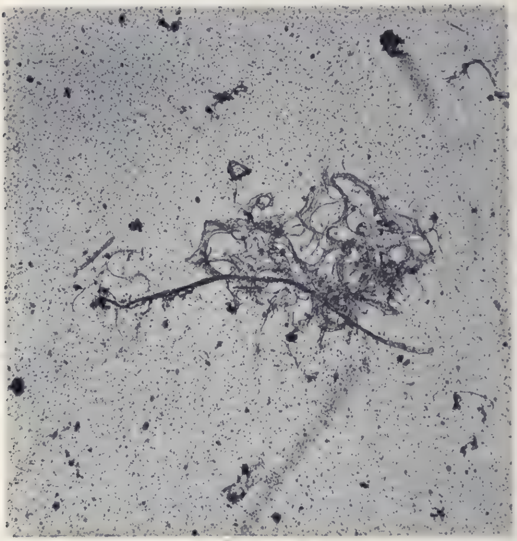

Fig. 295.—Sputum: Case of lung abscess. Elastic fibers.

ribs below where operation proved it to be. I believe this error may be due to the fact that x-ray plates are taken with the lung in the position that it assumes in full inspiration. At operation the lung is not in this position, and we have found that we were one or two ribs too low. Unquestionably, the most favorable cases for operation are those in which the x-ray shows the lesion to be situated near the periphery of the lung and in which a fluid level can be demonstrated. I hesitate to advise

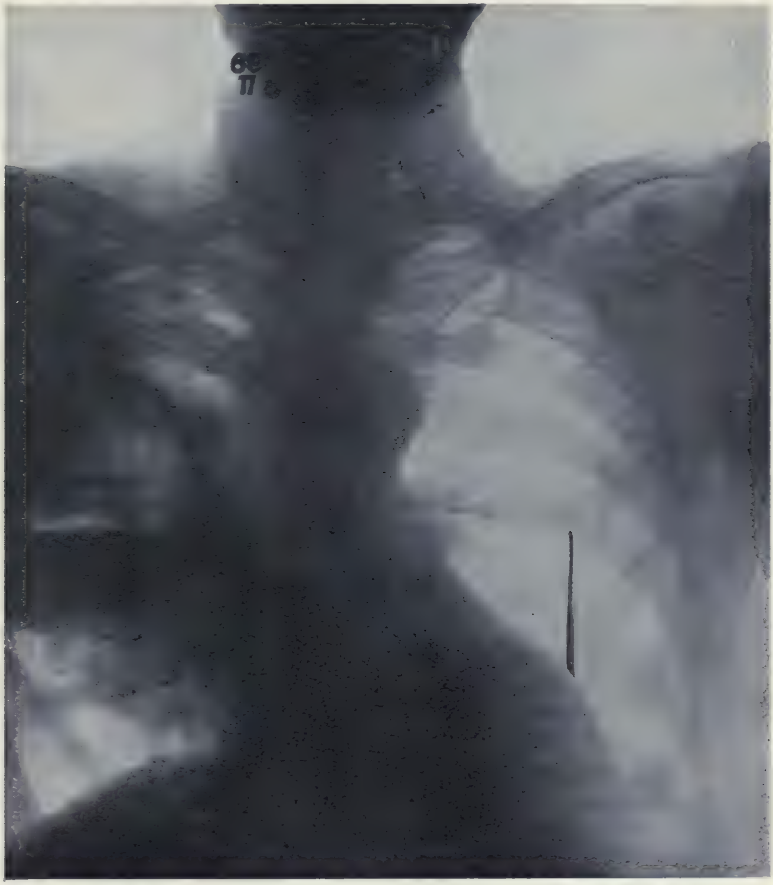

Fig. 296.—Very large lung abscess cavity, showing fluid level.

operation in those cases in which the x-ray, in spite of plates taken before and after the patient has attempted to empty the cavity, fails to show a fluid level, especially if situated near the periphery of the lung. On the other hand, it has been my experience that often x-ray fails to demonstrate a fluid level in those cases in which the abscess is situated near the hilum.

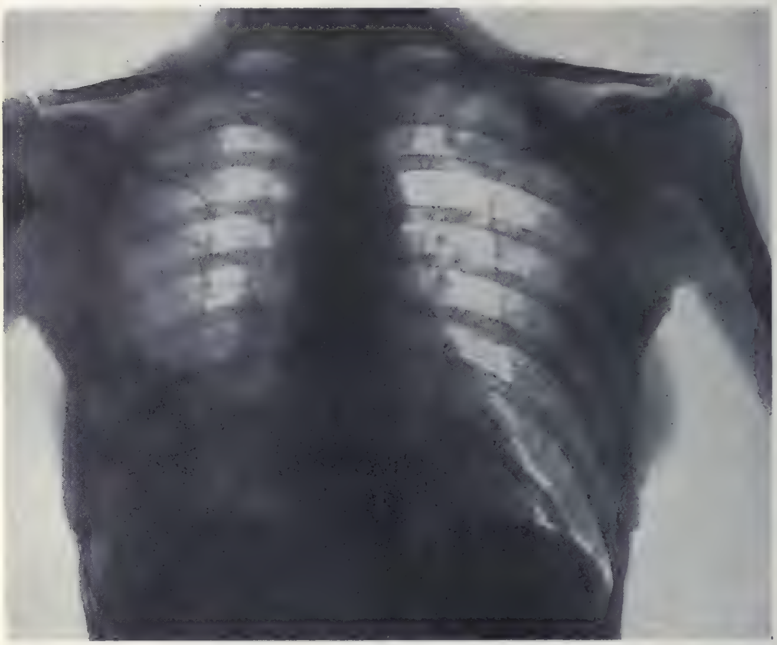

Fig. 297.—Lung abscess at level of ninth rib. At operation abscess was between seventh and eighth ribs.

4. *Physical Examination.*—This examination is disappointing in many cases. In those cases in which the abscess is very deeply situated about the lung root there may be no signs suggestive of an abscess, and even in cavities in the periphery of the lung the signs may be very slight. However, in most cases there is some change from normal that can be demonstrated, slight though it may be. The most common sign found is dulness on percussion. Other signs are variable; diminished voice, whisper.

and tactile fremitus may be present; on the other hand, increased voice, whisper, and tactile fremitus may be present when the cavity communicates directly with a bronchus. The typical classical signs of cavity—tympany on percussion, amphoric breathing, and cracked-pot resonance—are seldom found.

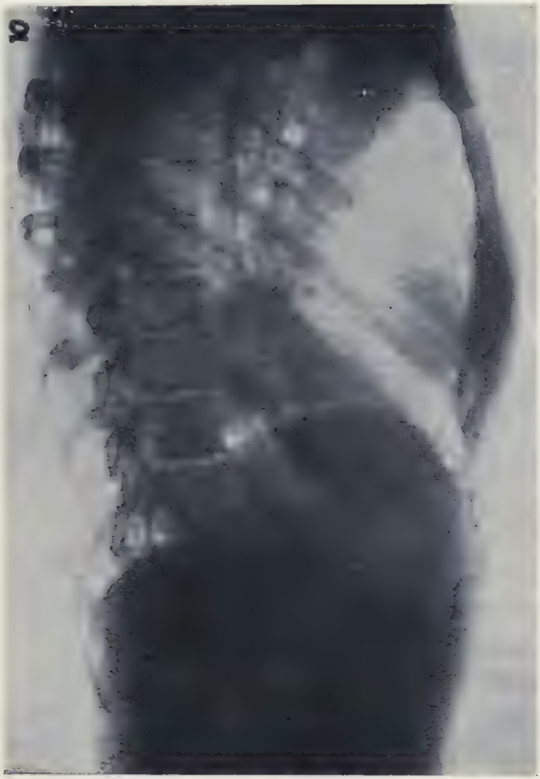

Fig. 298.—Lateral view of lung abscess. Sometimes this view is of great aid in localizing the process.

No hard-and-fast rules can be laid down for or against operation. Each case must be decided on its own merits. In cases in which the sputum is not foul, small in amount, not over 1 or 2 ounces in twenty-four hours, only slight or even absent signs of sepsis present, it is well to delay operation, making careful observation of the patient's condition. Cases that are apt to heal spontaneously make marked progress in three or four weeks. If progress has not been satisfactory during this time, then operation is indicated. In cases in which the sputum is very foul, with signs of considerable sepsis, operation is indicated regardless of the duration of the lesion. Well localized abscesses that are situated near the periphery of the lung, in which *x*-ray shows a circumscribed shadow, with a central area of diminished density and a fluid level, offer the best chance for surgical cure. Cases in which the abscess is situated near the hilum are difficult to find at operation, and the results of operation are not as good as when the abscess is near the periphery of the lung. In delaying operation there is always some danger of the infection spreading, of brain abscess, septicemia, or pyemia. Case 7 of my series refused operation and died within two weeks of entering the hospital, and at autopsy a brain abscess was found.

Undoubtedly a small number of cases spontaneously recover. Lord reports 7 out of 100. Hedblom quotes statistics collected by Lenhartz from three municipal hospitals in Berlin, 1905, in which there was a mortality of from 60 to 100 per cent. following expectant treatment. Lord in his series of 100 cases reports of 38 cases not operated on a mortality of 63 per cent. In a small series of 21 cases of my own reported in 1920, 3 spontaneously recovered. It seems probable that not more than 10 out of 100 cases may be expected to spontaneously recover. Even in the cases that do recover without operation it seems to me that the diagnosis may be open to question. In 2 such cases that I have seen, although a diagnosis of lung abscess was made, yet *x*-ray failed to demonstrate a fluid level, and there was no operation to prove the condition. We may have had some other condition present. Occasionally there is a case so sick, when seen, that probably any operative interference would be followed very shortly by death, and in these cases it is necessary to postpone operation until the patient's condition improves. Case 43 in this series entered the hospital desperately sick, and blood-culture showed a streptococcus septicemia. This case was not operated on and died four days after entrance.

It is important to know the mortality following operation as well as that without operation. Lord, in his series of 100 cases, reports only 6 deaths in 62 cases operated upon; a mortality of 9 per cent. Hedblom reports 54 cases at the Mayo Clinic in 1919, with a mortality of 33.3 per cent., and 17 personal cases, with a mortality of 23.5 per cent. In 1915 I reported 27 cases at the Massachusetts General Hospital, with a mortality of 25 per cent., and in 1920 a series of 17, 1 of which died, a mortality of 5.8 per cent. In this present series of 45 cases I personally operated on 31, 5 of which died, a mortality of 16 per cent. The mortality will vary probably between 15 and 35 per cent., according to the kinds of cases, as some abscesses are distinctly easier to operate on than others, being situated in more favorable places, and it will vary also according to the condition and age of the patient, and according to the experience of the surgeon.

What has the patient to look forward to, supposing the operation to be successful in that the abscess is drained and he leaves the hospital in an improved condition? Hedblom reports 66.6 per cent. of the acute cases of the Mayo Clinic cured or improved and 41.1 per cent. of the chronic cases cured or improved. Lord finds only 16 per cent. cured by operation. The acute cases may be said generally to heal and stay well after drainage for from two to four weeks, whereas in the chronic cases it is necessary to drain them for a much longer time, often for months, and indeed it may be necessary to continue drainage indefinitely, as when the sinus is allowed to close there will be a recurrence in most cases. But even in these cases it is far better for the patient to drain a small amount of pus daily through his sinus than to have the abscess recur, with the expectoration again of a large amount of pus. It seems true that in a large proportion of the chronic cases that are successfully drained the surgical procedure used fails to cure the condition. It is true that the general condition of the patient is improved, sometimes permanently and sometimes only temporarily, cough and expectoration may cease, and there may be only a very slight amount of discharge from the sinus, but let the sinus close or let the resistance of the patient be lowered, and there will be a rapid recurrence of symptoms.

Cases 23 and 30 are good illustrations. Case 23 was a man in the 40's, with an abscess in the right upper lobe. Following operation his cough and expectoration stopped, but he was drained, intentionally, until there was a small fistula, from which in twenty-four hours there were only 2 or 3 drops of pus. At the end of five months he was in fine condition and back at work. He then stayed drunk for a week, with the result that all his symptoms returned. Case 30 was a girl of fourteen years with an abscess in the right lower lobe, which was drained, and her cough and expectoration ceased. Three months later, in spite of careful directions given to her and her family, her doctor insisted on removing the drainage-tube. The sinus rapidly closed and again all her symptoms returned.

Operation.—Anesthesia plays a very important part in the immediate operative results. Local anesthesia is the one of choice, and can be used in all cases in which the lung is adherent to the costal pleura, but cannot be used in those in which the lung is not adherent unless a two-stage operation is done. Fortunately, we know that in the majority of cases the lung is adherent, but unfortunately we have no means of determining before operation whether or not this condition exists. In the cases that are not adherent some form of positive pressure anesthesia must be used if the abscess is to be found and drained at one sitting.

Although there can be no question but what the two-stage operation is the safest, yet in using this procedure in a number of cases the abscesses have not been found, and so this technic has been abandoned. The only sure way of localizing the abscess is by palpation and inspection. The surgeon who is going to do thoracic surgery should spend as many hours as possible at the autopsy table educating his sense of touch to familiarize himself with lung conditions. There is one golden time to find the abscess, and that is at the first operation. After opening a window down to the pleura, this should be inspected and palpated. If the pleura is thickened and grayish in color, one may feel sure that the lung is adherent and that the abscess is not far distant. Occasionally, although to inspection the pleura may appear normal, yet by palpation a firm hard sense of resistance is felt, and again one may be sure that the region of the abscess is found. If, on the other hand, the pleura is normal and the lung seen moving under it, the chances are that the abscess is not in this region. More ribs should be removed and further inspection and palpation done. As the majority of abscesses are in the periphery of the lung, and in most instances the lung is adherent to the costal pleura in the region nearest to the lesion, this place must be found. In cases in which the abscess is deeply situated, and the lung not adherent, the pleural cavity should be opened under positive pressure and the lobe of the lung palpated. After localizing the region of the abscess this region should be sutured to the costal pleura. It is safe to wait two or three days for adhesions to form before opening the abscess, as if it is opened at this time there may be a leakage of pus through the suture, with an empyema resulting. But in cases in which it seems unwise to wait, the abscess may be opened, using gauze for walling off in addition to the suture. Cases 30 and 32 were operated upon in this way, Case 32 developing a small empyema, which was easily taken care of. Case 30 did not develop empyema. The technic of opening the abscess will vary according to the operator. I see nothing to be gained by aspiration, except to give the surgeon some moral support, as if one does not find the abscess with the needle, it does not at all imply that there is no abscess present. I have always made an incision into the lung and then opened into the abscess with my finger. In most cases, having opened the abscess, pus will be seen. However, in a few no pus is seen, but the operator is greeted with a blast of very foul-smelling air. These are the two proofs that the abscess has been opened. In the cases in which foul-smelling air but no pus is demonstrated, if drainage is established from this area, pus will be coming out within forty-eight hours. It may be a good technic to pack the cavity with gauze for several days to control any bleeding that may take place, but patients do not like it, as until good drainage is established they still cough up large amounts of pus. Probably the best technic is to place a soft-rubber tube into the cavity and pack gauze around it.

It is necessary to drain the chronic cases indefinitely and the acute cases at least three or four weeks. The position of the drainage-tube must be changed at least every forty-eight hours, and it is better to change it every twenty-four hours. This is done to prevent hemorrhage caused by the end of the tube ulcerating through the wall of any blood-vessel that it may rest on. In one case that I had six years ago the position of the

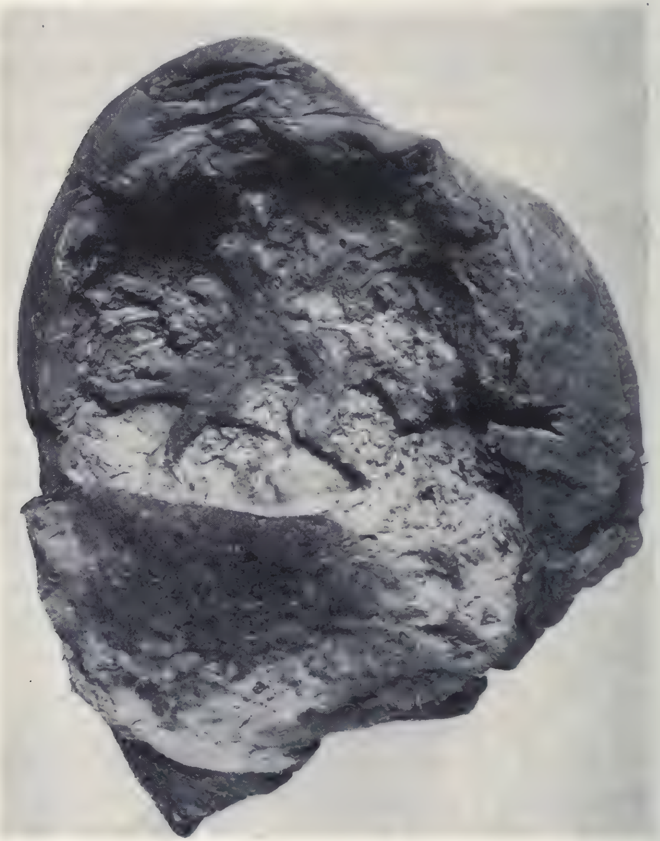

Fig. 299.—Gangrenous abscess cavity involving greater part of upper lobe.

tube was not changed, and on the sixteenth day following operation there was a severe hemorrhage, but fortunately not a fatal one. Postoperative hemorrhage is a very real danger in spite of frequently changing the position of the drainage-tube. Not infrequently we have had a hemorrhage some time between the third and tenth day after operation. This we have been able to control, so far, in all cases. At times it has been necessary to open the wound and pack the cavity, but the trauma caused by this procedure tends to spread the infection.

This series of 45 cases are those that I have seen during the last four years, and I believe the diagnosis of lung abscess was correctly made in each case; 40 were at the Massachusetts General Hospital and the remaining 5 outside the hospital. Out of 31 cases that I operated upon, 5 died following operation, a mortality of 16 per cent.; 5 spontaneously recovered; 4 were operated upon by other surgeons outside the hospital. Of these, 1 entered the hospital two years later and died following an operation for empyema. A second case died eight days after operation, with symptoms of "meningitis." The other 2 I cannot trace. Of my own cases, 2 patients refused operation and left the hospital, and 3 died without operation; 1 of these, Case 7, refused operation, and died from a brain abscess; the second, Case 43, was a man sixty-three years old, and died of streptococcus septicemia a few days after entrance, and at autopsy the middle lobe was a large gangrenous cavity. The third case, No. 45, was desperately sick on entrance and died before the lesion could be localized. This death was very sudden and probably was due to a cerebral complication.

It is interesting to analyze the 5 deaths following operation in this series of mine to see if any information can be gained, so that better results may be obtained in the future. Case 19 was a strong young man who developed pneumonia following a gastric operation. Abscess of the lung developed and he was operated upon under gas-oxygen anesthesia. Lobar pneumonia on the other side appeared within three days and he died three days later. Autopsy showed this, and that the abscess had been correctly drained. There seems to be little question but what if the operation had been done under local anesthesia the pneumonia might not have developed. Case 22 was a man in the late 50's. At operation there was a large amount of foul, thin pus, and large masses of necrotic lung tissue were floating in the cavity. Some of these were removed at the time and others drained out after operation. This was probably a gangrenous condition, and he did not enter the hospital early enough while the process was a comparatively small abscess, but waited until the destructive process had gone on too far. In this case with earlier operation the outcome might have been different. Case 27 was a strong fat woman in the early 30's. Three days after operation she had a severe hemorrhage, although the cavity was drained with a soft tube and gauze packing. It was necessary to open the wound and pack the cavity. She developed cerebral symptoms suddenly three weeks after operation when we thought her well on the road to recovery. She died and, unfortunately, there was no autopsy, but she probably died from a brain abscess. It is a question whether or not the packing of the cavity to control the hemorrhage had any bearing on this. Cases 28 and 31 were deeply situated abscesses that drained very satisfactorily following operation, but both ran high septic temperatures and died with septic symptoms three to four weeks later.

In summing up these 5 deaths it seems probable that the first was due to poor judgment in using a general anesthetic; that the second should have been operated upon earlier; that in the third case if the cavity had been packed more tightly at operation a secondary hemorrhage might have been avoided, and so the fatality might not have occurred, although this cannot be certain, as the patient did not die from hemorrhage. But in the last 2 cases I fail to find any evidence of bad judgment or technic which could be improved with the hope of avoiding future failures.

It has been difficult to trace the final results of the 26 cases of my own that recovered from the operation; 12 have remained well over periods varying from five months to two years; 3 cases are still discharging a little pus from their sinuses; 2 of these are free from cough, but the other is still coughing and raising some pus; 2 cases recurred, as the drainage-tubes were taken out too soon and contrary to our orders; both cases were drained again at secondary operations. One case died from puerperal sepsis, 1 case from brain abscess six months after operation. In 3 cases tubercle bacilli were found in the sputum three to four months after leaving the hospital, and the remaining 4 have not been traced. Were the 3 cases in which tubercle bacilli were found some time after operation tubercular abscess at the time of operation? Two of these were upper lobe abscesses and 1 was in the lower lobe. We are, naturally, more suspicious of upper lobe lesions being tubercular than lower lobe ones. The greatest possible care has been taken in all cases, preceding operation, to eliminate the danger of operation on tubercular abscesses, and the sputum is examined many times. Tubercle bacilli were not found in any of these 3 cases during repeated examinations before operation. It seems possible that the severe trauma caused by operation and prolonged drainage may light up a latent tubercular condition or make the lung more susceptible to tubercular invasion.

Although 12 cases are considered well, and another 5 are improved, and may eventually become well, yet in these results only 60 to 70 per cent. of the cases successfully operated upon are permanently cured or improved.

SUMMARY

1. Many cases of lung abscess could be avoided by a more careful technic in removing tonsils, adenoids, and teeth.
2. It seems possible to make a differential diagnosis between lung abscess and bronchiectasis in a majority of the cases.
3. Lung abscess cases that do not definitely improve in three to four weeks should be operated on. Operation should be done before the case becomes chronic, as the chances of permanent cure are much greater in the acute stage than in the chronic stage.
4. There will always be some mortality, varying with the kind of case.
5. Early diagnosis and early operation will produce the best results.

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CLINIC OF DR. LINCOLN DAVIS

Massachusetts General Hospital

THE SURGICAL TREATMENT OF CARCINOMA OF THE CERVIX UTERI

At the present time there is a marked tendency in many clinics toward the abandonment of the radical operation for cancer of the cervix in favor of radium treatment. In these same clinics radical operations are being prosecuted with great vigor in cases of cancer of the lip, tongue, breast, stomach, colon, and rectum. What is the reason for this?

It can be said at once that radium has so far not proved itself of great value in cancer of deep-seated organs, such as the stomach and intestine, so that in those regions reliance must still be placed on surgery. As regards cancer of directly accessible organs, such as the lip, tongue, mouth, and cervix, the general attitude of cancer experts has been well expressed by Dr. R. B. Greenough at a recent meeting of the New England Surgical Society. He stated that radical operations for the cure of cancer are based on the fact that removal of the regional lymph-nodes, as well as the local focus of disease, has been proved to result in a larger number of cures than when the latter was merely removed; the radical operation permitting of cure when the disease has extended beyond its point of origin. He continues as follows: "For this reason the treatment of cancer of the lip by radium must be regarded as a step backward to the time of the early and incomplete operations for the cure of this disease. In fact, the radium treatment of operable cases of cancer of the lip is not countenanced in the best clinics.

"When we come to cancer of the cervix, conditions are not quite the same. The Wertheim operation is intended to accomplish in cancer of the uterus what the 'complete' operation does in cancer of the lip or cancer of the breast. There is little evidence, however, that cases of cancer of the cervix which have extended beyond the point of origin are cured by the Wertheim operation. The operation is one of great technical difficulty, attended by a considerable mortality, and with frequent and annoying complications. Under these circumstances we must consider whether the destruction of the local lesion by radium without mortality and without complication does not offer advantages over the radical operation."

In considering this question I do not wish for a moment to decry the merits of radium; I have observed personally some most encouraging results from its use in cancer of the cervix, and would agree that it is time now instead of only referring the hopeless cases of cancer of the cervix for radium, to refer for treatment with radium alone a limited series of early and operable cases. Radium has doubtless earned for itself the right to a fair and full trial alongside of surgery. No one would welcome more than the surgeon something better than the Wertheim operation. It is to be hoped that radium will fulfil the expectations of its advocates in this regard, but as yet it cannot be said to have proved its position. Until this is done I wish to protest against the discarding of the operation of radical abdominal hysterectomy in cancer of the cervix. This much-maligned operation is not the surgical *bête noir* which it has been generally considered; it has proved itself of real curative value in hundreds of cases in the past and is capable of a still better record in the future I believe.

It has been urged that when cancer is limited to the cervix, simple complete hysterectomy, either vaginal or abdominal, without the extended dissection of the Wertheim operation, is adequate, and that when the disease has progressed beyond these limits surgery is not worth while. Dissection of the pelvic lymph-nodes as originally advocated by Wertheim is not endorsed by the majority of operators in this field at the present time. It seems to offer too little chance of success to warrant the increased expenditure of time and enhanced risk.

Wide removal of parametrial tissue, as well as a liberal cuff of vaginal wall, however, are essential features of the radical operation, and are as rational, it seems to me, as is the removal of a wide margin of skin and the pectoral muscles in a complete operation for cancer of the breast.

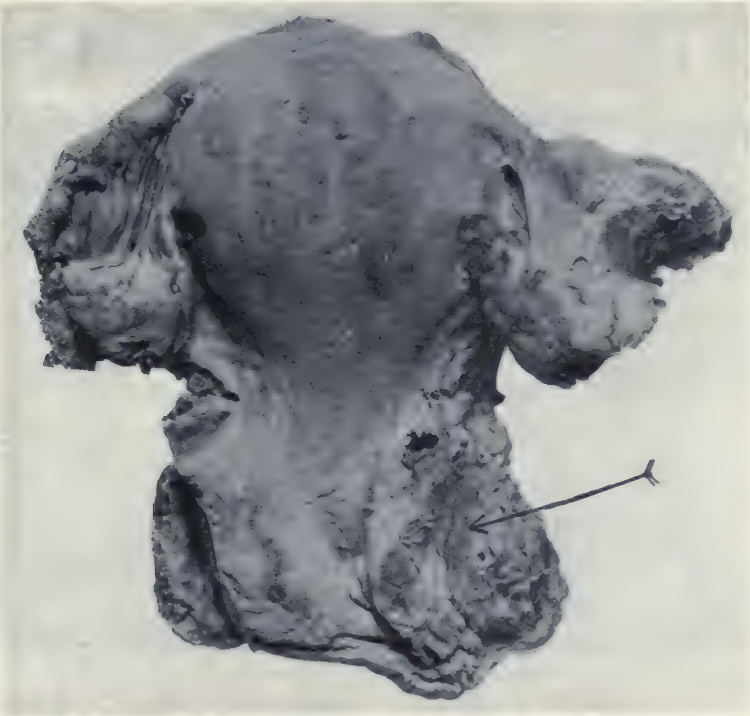

Fig. 300.—Case 1. Posterior view of uterus, arrow points to invaded parametrium.

That the radical operation is capable of curing, for at least a number of years, cases in which the disease has extended beyond the point of origin is attested by the following 2 cases:

Case I.—P. P. Hospital No. E. S., 209,616. An Italian woman, forty-seven years old, the mother of 11 children, entered the Massachusetts General Hospital on July 24, 1916. On examination the cervix was found to be replaced by a hard, ulcerated mass bleeding freely on touch and fixed on the right side to the vault of the vagina. A radical abdominal hysterectomy, with ligation of both internal iliacs, was done, with removal of parametrium and a liberal cuff of vaginal wall (Fig. 300). The specimen was examined by Dr. H. F. Hartwell, Clinical Pathologist of the Massachusetts General Hospital, who found squamous-cell carcinoma of the cervix, with invasion of the right parametrium (Fig. 301). The patient made a good convalescence, except that pyelitis supervened on the thirteenth day, with some leakage of urine, which it was feared might be due to a fistula; this ceased, however, in a few days and gave no further trouble. She was last seen on March 22, 1921, four years and eight months after operation. Her general health was excellent; she was working hard daily, caring for her large family. There was some diastasis of the recti muscles, with considerable rectocele and cystocele. Examination of the pelvis was otherwise entirely negative.

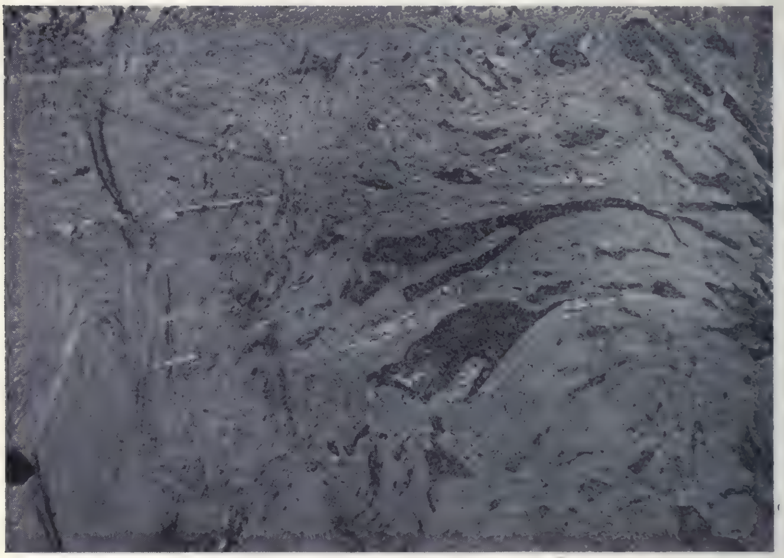

Fig. 301.—Photomicrograph of section of parametrial tissue taken at point indicated by arrow in Fig. 300.

Case II.—A. L. B. Hospital No. E. S., 212,108. A married woman, fifty-three years old, entered the Massachusetts General Hospital on December 11, 1916. She had been twice married and had 3 children; two died in infancy, 1 was living and well; no miscarriages. Menopause at forty-seven. For four years previous to admission she had complained of a heavy feeling in the pelvis, with backache, and later pain in the left lower quadrant. Two months previous to admission she first noticed a brown watery discharge. She consulted a doctor on October 19th and entered the hospital on December 11, 1916. On examination there was a nodular growth involving the cervix, with slight involvement of the vaginal wall. The uterus was movable. Radical abdominal hysterectomy was done; the internal iliacs were not tied. A liberal amount of parametrium and vaginal wall was removed with the uterus. Dr. H. F. Hartwell reported "Epidermoid carcinoma of the cervix, with infiltration into the parametrium." The patient made an uneventful recovery. She was last seen on May 29, 1920. She was working daily in a shoe factory, vamping shoes, and had not lost a day's work in three years. On examination, the abdominal scar was solid. Vaginal and rectal examination was negative except for a smooth scar across the vault of the vagina. A letter of March 4, 1921 reports that she is still perfectly well, four years and three months after operation.

Considerable series of cases of radical abdominal hysterectomy have been reported, showing very favorable results; notably, the much quoted report of Wertheim which was published in 1912, recording 675 cases of radical abdominal hysterectomy, with an operative mortality of 16.6 per cent., and 43 per cent. of five-year cures in 380 traced cases. Farrar Cobb has recently reported the remarkable figures of 57 per cent. of five-year cures in 35 cases of radical hysterectomy, with an immediate operative mortality of 11.6 per cent. in 60 cases. My own statistics are as follows:

Total of personal cases at the Massachusetts General Hospital	64	
Hysterectomies	27	
Operative deaths	3	11.1 per cent.
Palliative operations	34	
Operative deaths	1	
No operation	3	
Operability (radical operation)		42 per cent.

Cases available for end-result data:

Radical operations prior to May, 1917	20	
Alive and well over eight years	1	
Died of cerebral hemorrhage without signs of recurrence seven years after operation	1	
Alive and well over four years	6	
(One of the above cases, reported well by letter four years and four months after operation, shows beginning local recurrence at end of fifth year	1	
Recurrences within one year	8	
Untraced	1	
Operative deaths	3	
Four-year "cures"	8	42 per cent.

These figures compare not unfavorably with the results obtained in operations for cancer elsewhere in the body in respect to both percentage of cures and operative mortality. The latter, while still high as compared with that of cancer of the breast, is distinctly lower than that obtained in cancer of the stomach or rectum. It is in operability that the figures for cancer of the uterus fall down. There is a marked variation in the figures of different surgeons, but, taken as a whole, the operability is lower than for other regions of the body except the stomach. If the surgeon finds 35 per cent. of his cases suitable for radical hysterectomy, and obtains a five-year cure in 35 per cent. of those so operated upon, he is curing only 12 patients out of 100 seen.

The crying need, then, is to get the cases earlier and thereby increase the operability. This is universally recognized. How is it to be done?

For a number of years there has been a well-organized, energetic, and far-reaching campaign carried on in the profession and among the laity with the hope of securing recognition of cancer at an earlier stage of the disease. The signs and symptoms of the early manifestations of the disease in various localities have been graphically described and the fact emphasized that cancer in its early stages is a local disease, capable of being cured by early and radical operation. It is obvious that in order to advance this campaign in cases of cancer of the uterus surgeons should show, first, that the primary operative mortality is not excessive, and second, that there is a reasonable chance of ultimate cure. Otherwise patients will continue to delay as they have done in the past until driven to the surgeon in the desperation of relentless pain and hemorrhage.

The estimated mortality for 1914 in the entire United States from cancer of the female generative organs was approximately 12,000. Of these cases cancer of the cervix made up probably nearly 90 per cent. Inasmuch as the annual increase in the death-rate of cancer is estimated at 2½ per cent. by competent authority, it would be fair to assume that at the present time at least 1000 women die every month in the United States as a result of cancer of the uterus. It is equally fair to assume that for every case that ends fatally a new case is developing, and hence, 1000 new cases of cancer of the uterus are developing in the United States every month.

In the very great majority of these cases the primary involvement is in the cervix of the uterus, an organ accessible to inspection and palpation by the simplest of examinations. Why, then, should it not be possible to detect a fair proportion of these cases in the early stages? That such is not the case, however, is only too well known. The majority of such cases are far advanced when they reach the hands of the surgeon. An operability of 50 per cent., that is, for the radical operation, has seldom been reached in any of the large clinics of the world. The figures range all the way from 10 to 40 per cent. The insidious nature of the onset of the disease is perhaps the principal cause of the low operability. Disinclination or dread of examination on the part of the patient, as well as a feeling of hopelessness on the part of both patient and doctor, are also contributing factors in the delay.

The earlier the case is operated upon, while the disease is still confined to the cervix, the easier is the technic of radical extirpation; the lower the immediate mortality rate, the less the likelihood of distressing complications, and the better the ultimate prognosis; and hence, the more inclined other patients will be to accept surgical treatment.

This sequence of events might be likened to an ever-expanding spiral as contrasted to the vicious circle established when advanced cases are subjected to radical operation. Under these circumstances up goes the immediate operative mortality; the chance of distressing sequelæ, such as fistulæ, is greatly increased, and the percentage of permanent cures diminished; hence, surgery gets a bad name, and patients with this disease keep away from the surgeon until driven to him by pain, by which time there is but little chance of cure.

Systematic examination of women who have borne children at the time of the menopause, or whenever irregular bleeding occurs, has been advocated. This is rational; it can be carried out to a certain extent, and a number of unmistakable carcinomas would doubtless thereby be discovered. It is in the detection of early carcinoma that routine examinations of groups of presumably healthy adults has its chief value. But it must be remembered that a cancer clinically undetectable at one time may in six months have become inoperable. Such a case has occurred in my own experience. Is it possible to go further and determine what is the suspicious or precancerous cervix? This is difficult ground, and presents great practical obstacles. At the Massachusetts General Hospital some 30,000 new cases are examined annually in the Out-patient Department. Of these, nearly one-half are women. There were in the year 1919 38 cases of definite malignant tumors of the female genital organs detected. These were all well-marked cases, capable of easy recognition. How many women may have passed through the clinic who were about to develop carcinoma? What is the precancerous cervix, how can it be recognized, and how should it be treated? It is obviously impractical to repair every laceration of the cervix after child-birth. Are there certain types of lesions of the cervix which predispose to the development of cancer? Undoubtedly there are, but just what they consist in is beyond my personal knowledge. We are accustomed to regard with suspicion and to advise amputation or repair in cases which have passed the child-bearing period in which there are deep, indurated lacerations with eversion and ectropion, bleeding on touch. Many of these suspicious cases have been subjected to operative repair, and specimens removed for examination during the last two years, but in no case as yet has carcinoma been found in the cases regarded as merely suspicious. In spite of this negative evidence there is encouragement for the pursuance of this policy in the history of a recent case.

Case III.—M. A. C. Hospital No. E. S., 240,557. Age forty-seven. Married. Seen in the Out-patient Department of the Massachusetts General Hospital on December 5, 1919. Chief complaint, menorrhagia. The menstrual flow had been excessive since birth of last child seven years before. She had had 7 children; no miscarriages. At the time of examination she was flowing three weeks out of every month, and had lost 20 pounds in weight. On examination there was marked rectocele and cystocele, with laceration of the cervix, which was ulcerated and bleeding. She was referred to the house, with a diagnosis of diabetes and question of carcinoma of cervix, and was admitted to the West Medical Service on December 5, 1919. The house record showed physical examination to be negative except for the following findings on pelvic examination: "Relaxation of vaginal walls; anterior lip of cervix long and smooth, posterior lip enlarged, irregular, and bleeds easily; cervix not fixed; no masses." Urine: Sugar present, 1.4 per cent. Blood-sugar, 0.22 per cent. Wassermann negative. On December 20, 1919 she was referred to the Surgical Service for treatment of cervix. A trachelorrhaphy was done, with excision of specimen. Microscopic report: No evidence of malignancy. Diagnosis: Endocervicitis with erosion.

After her discharge from the hospital she was referred to the Diabetic Clinic in the Out-patient Department. The diabetic condition was a mild one, which yielded promptly to treatment.

On December 22, 1920 examination of the cervix in the Out-patient Department showed on the posterior lip a granulating area the size of a dime, hard to the touch, bleeding easily, and raised above the surrounding surface. It was believed to be very suggestive of malignancy, and the patient was again recommended to the house.

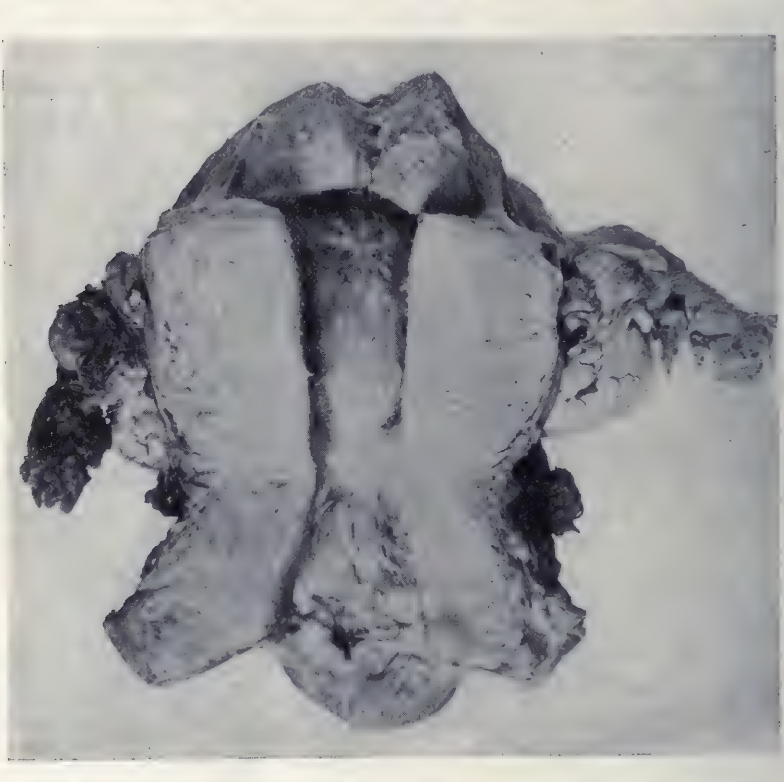

Fig. 302.—Case III. Showing localized carcinomatous lesion on cervix.

During the past year she had had the usual prolonged menstrual bleeding, and, in addition, during the last six months had noted a small amount of blood on the napkin at all times. No pain. No leukorrhea.

On January 27, 1921 radical abdominal hysterectomy was done, with ligation of the internal iliacs. The uterus, with a generous cuff of vaginal wall and a fair amount of parametrium on each side, was removed. The patient was discharged from the hospital on February 18th in good condition. Microscopic examination of the uterus showed typical early carcinoma of the cervix (Figs. 302, 303).

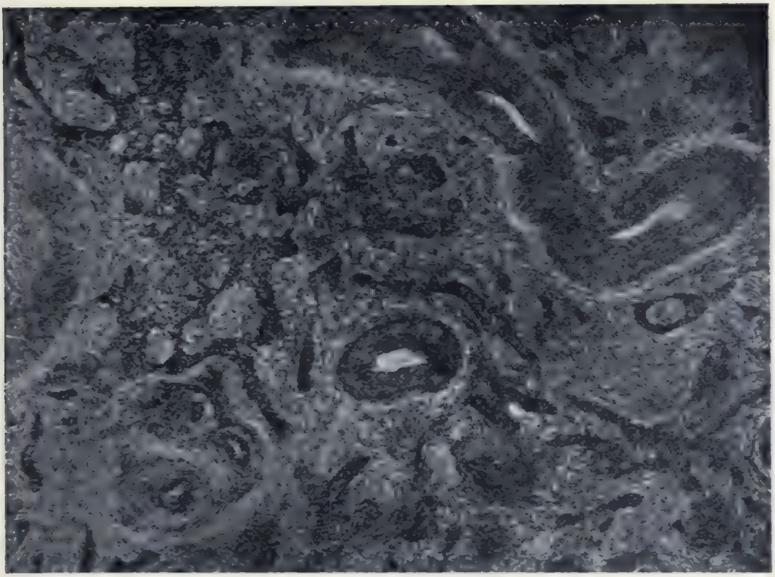

Fig. 303.—Case III. Photomicrograph showing infiltrating carcinoma of cervix.

In this case it is interesting to note that there was clinical suspicion of malignancy before it could be established by the microscope. It is interesting to speculate as to what the results of an amputation of the cervix flush with the vault of the vagina at the time of the first entry into the hospital would have been. My personal feeling is that such a procedure would have prevented the incidence of carcinoma in this case.

CLINIC OF DR. W. E. LADD

Children's Hospital, Boston

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

The condition of pyloric stenosis of infancy has come to be more clearly defined than in the past, and with its definition and employment of suitable treatment unquestionably many infants' lives have been saved which formerly would have been lost under rather vague diagnoses, such as marasmus.

That the condition is of congenital origin has been firmly established by its being found in the fetus by several observers. The reason that its symptoms do not usually manifest themselves before the tenth day is not entirely clear. The most plausible theories are that with the increased amount of food and possibly larger curds the mucous membrane inside the unyielding pyloric tumor becomes somewhat thickened and causes almost complete obstruction in the opening which during the first few days of life was sufficient to let small amounts of milk through.

The findings of some surgeons that the tumor increased in size and hardness with the age of the patient has not tallied with my observations. Some of the largest tumors causing the most complete obstruction have been found in the youngest patients. In fact, the patients who come to operation late are usually those who have the lesser degree of stenosis and show a smaller tumor. In the past there has been considerable discussion about pylorospasm and true pyloric stenosis. Holt's teaching, that there is no such thing as pylorospasm, these cases being mild degrees of stenosis, has been quite broadly accepted. Though this discussion may have been the result of a confusion of terms, it seems to the writer that not only are there considerable degrees of variation of stenosis but also a distinct class of case which may be properly termed "spasm."

When the operation of pyloroplasty was first introduced it seemed as though it should relieve what we had been accustomed to call "pylorospasm" cases. The writer operated on two such patients and found the pyloric muscle though quite as large as some of the true stenosis cases, soft, vascular, and moderately difficult to free from the mucous membrane. Though symptomatically these patients resemble the stenosis cases closely, the difference in findings at operation as well as the difference in *x*-ray picture justifies the distinct classification.

With the marked degree of stenosis the history and physical examination give such a clear and definite picture that the diagnosis presents few difficulties.

Case I.—A breast-fed baby three and one-half weeks old did fairly well for the first ten days, when he began vomiting some of the feedings; at two weeks the vomiting had increased and the baby had not regained his birth weight. At three weeks he vomited every feeding. The vomiting came soon after nursing, was forceful in character, projecting the milk 3 or 4 feet. The baby had lost weight rapidly—6 ounces in the last three days. The stools were infrequent and scanty in amount.

On physical examination the baby was seen to be thin, the skin loose and somewhat dry, the fontanels slightly sunken. The epigastrium prominent and large peristaltic waves seen running across it. Just under the border of the liver and to the right of the midline a tumor about the size and shape of a small olive was felt. Examination of the baby otherwise was not remarkable. *x*-Ray of a bismuth meal shows a large stomach with the characteristic large rounded pyloric end and no bismuth passing through to the duodenum (Fig. 304). This patient presented all the characteristic features of pyloric stenosis of marked degree, and operation was therefore decided on.

The baby's arms, legs, and chest were wrapped in flannel bandages and the baby placed on a warm hot-water bottle on the operating table. A No. 14 French rubber catheter was introduced through the mouth into the stomach. This is done as a routine to facilitate etherization. If this detail is omitted etherization is sometimes difficult, presumably due to pressure of a dilated stomach on the diaphragm. A high rectus incision was made and the pylorus delivered into the wound. The pylorus presented quite a large hard tumor. It was rotated downward until the bloodless area almost opposite the greater curvature was uppermost. An incision was now made longitudinally deep into the pyloric muscle from its duodenal to its gastric end. When the incision was made, the pyloric muscle was found to be almost cartilaginous in character and practically bloodless. With the handle of the scalpel the incision was spread until the mucous membrane could be seen. Next the ends of the thumbs were put into the incision, which was further spread until the mucous membrane pouted up above the peri-

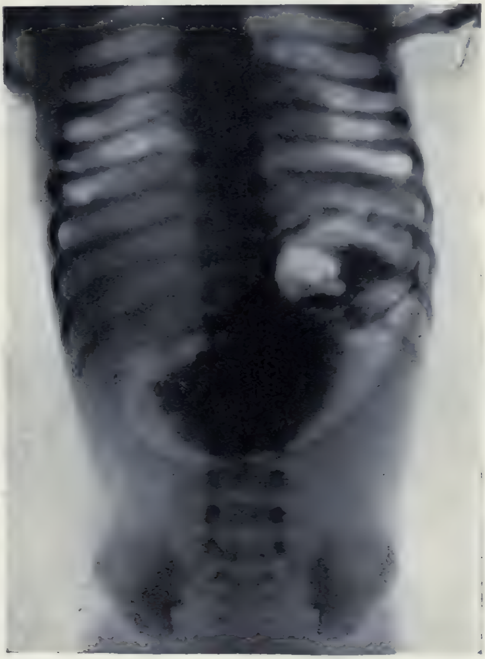

Fig. 304.—*x*-Ray of bismuth meal of Case I.

toneal surface. This detail is important and prevents the pyloric muscle from closing up and making the result a failure. There being no bleeding, the pylorus was dropped back into the abdomen, the wound in which was closed in layers. The operation was of short duration and feeding consisted of 1 ounce of whey started one and a half hours afterward. The feeding for the first twenty-four hours after operation consisted of 1 ounce of whey hourly; the next twenty-four hours, of ½ ounce of whey and ½ ounce of breast milk hourly. Following this the amount and strength of the food was increased gradually and the interval lengthened, until at the end of a week the baby without being picked up was breast fed at three-hour intervals. The convalescence was without incident, the stitches removed on the tenth day from a wound healed *per primam*. The baby was heard from at one year of age and had nothing unusual to report. Was considered a healthy normal baby weighing 23 pounds.

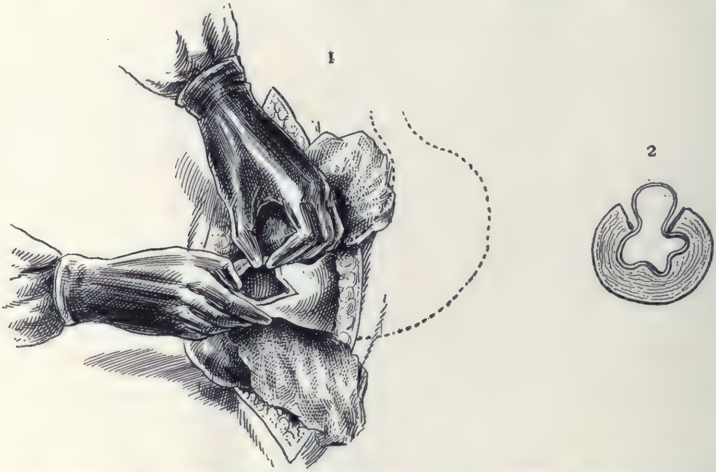

Fig. 305.—1, Method of spreading pyloric muscle with thumb and finger. 2, Wound showing mucous membrane pouting up above peritoneal surface.

Such is the history and result to be expected in a case of pronounced pyloric stenosis operated on by pyloroplasty while still in moderately good condition.

Case II.—The next patient is a breast-fed baby nine weeks old who did fairly well for the first three weeks of life and gained a small amount. At three weeks of age the baby began vomiting some of its feedings. From that time to nine weeks of age the vomiting progressively increased until the infant lost most of her feedings, but occasionally holding one or two down. At nine weeks the baby was just under her birth weight and presented a very similar picture to the case cited above on physical examination. The *x*-rays (Figs. 306, 307) show the large stomach, with characteristic rounded pyloric end and accentuated

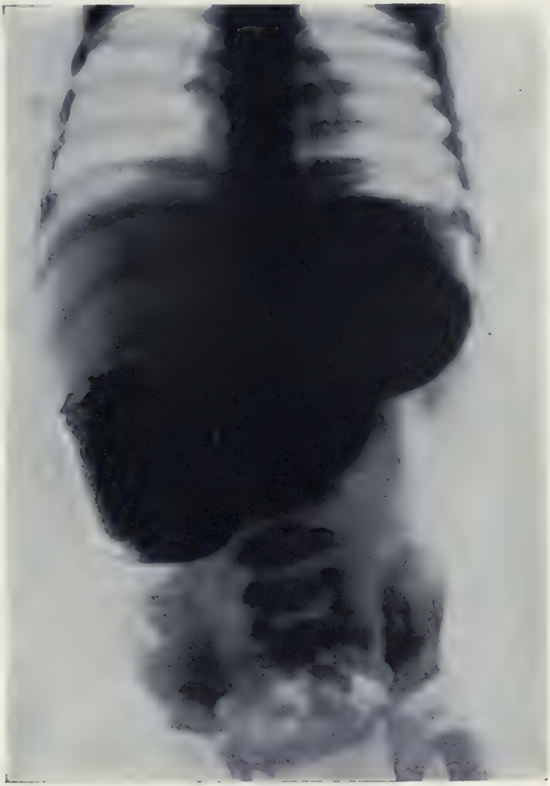

Fig. 306.—*x*-Ray of bismuth meal of Case II immediately after ingestion, showing moderate degree of stenosis.

peristaltic waves, but with a moderate amount of bismuth passing through to the small bowel. This baby was operated on by the same method as used in the previous case mentioned. A moderate sized pyloric tumor was found. The convalescence was uninterrupted but for occasional regurgitation of small amounts of milk during the first week after operation. The ultimate recovery was complete. This case represents the type of stenosis of moderate degree which is likely to become complete at any time, and for which operation should be done before

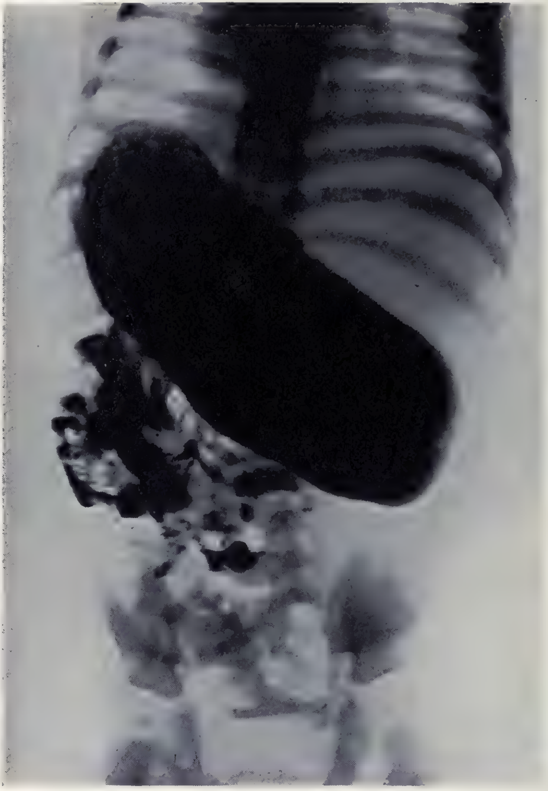

Fig. 307.—*x*-Ray of bismuth meal of Case II two hours after ingestion, showing moderate degree of stenosis.

the infant is *in extremis*, and when so done yields most gratifying results.

Case III.—The third case I wish to cite is of a baby eighteen days old, partly breast and partly bottle fed. This baby has not done well since birth. He started vomiting on the fourth or fifth day, and as he vomited the breast milk his doctor tried weak modifications, which were likewise vomited. The baby was much under weight, thin, fontanels depressed, and the skin loose and dry. On examination of the abdomen, peristaltic waves were seen in the epigastrium crossing from left to right.

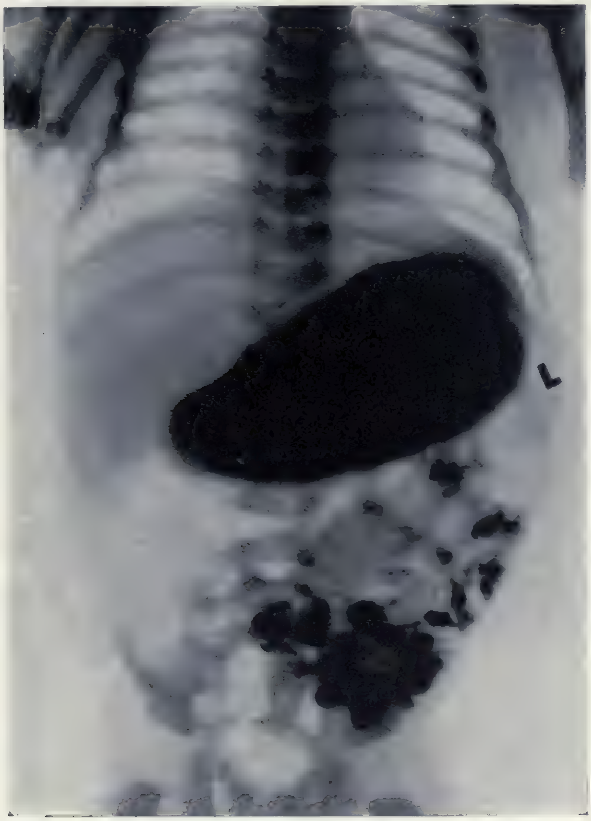

Fig. 308.—x-Ray of bismuth meal of Case III one-half hour after ingestion, illustrating pylorospasm.

The epigastrium was, however, much less prominent than in either of the preceding patients. No tumor could be felt. x-Ray (Fig. 308) shows the pyloric end of the stomach much smaller and less rounded than in either of the other two, and considerably more bismuth passing through. A No. 14 French catheter was passed through the pylorus, as evidenced by the obtaining of bile through the tube. This patient was not operated on, but put in charge of a good pediatrician, who has reported that the baby is doing well with careful feeding. This patient the writer has classified as pylorospasm. Though she had many points of similarity to the stenosis cases, there are still distinct differences in the physical examinations in the x-ray findings and, the writer believes, in the pathology.

Though in the great majority of cases the history is so characteristic and the physical examination so definite that a diagnosis of stenosis can be made without other aid, in such cases I would be in entire accord with the point of view expressed by Downes, that the use of the Roentgen ray is not necessary and sometimes even unwise. However, I am also fully convinced that there are border-line cases in which the use of the x-ray or duodenal tube, or both, may establish the correct diagnosis and the suitable treatment with more precision and safety and less waste of time than by experimenting with feeding as he suggests. It would seem that Downes had been unduly influenced against the use of the x-ray by an unfortunate death resulting from the delay caused by an unnecessarily prolonged observation of a bismuth meal. Three or four hours is sufficient time to gather almost all available data regarding the infant's stomach, while two or three hours will often give sufficient data to justify one in deciding for or against operation. Likewise evidence gained from the duodenal tube in a few minutes may be sufficient to make one decide against operation. The use of the duodenal tube should not be confused with the repeated passage of a stomach-tube for the purpose of determining gastric retention. This practice may be not only unenlightening, but very exhausting and harmful to the patient.

Given an infant with pyloric stenosis, what treatment should be employed? In the past the results of surgery were so uncertain that pediatricians were rather loath, and quite properly so, to recommend it. At present the results are so uniformly successful that no one should hesitate in recommending operation for the relief of this condition. This change has been brought about by the simplification of the operation and attention to the details in its performance. Posterior gastro-enterostomy, which has successfully relieved some patients in the past, was found to be too formidable an operation, and has been practically entirely discarded. The operation of pyloroplasty as now done has been evolved as the result of work done by Fredet, Webber, Ramstedt, Keefe, and others, and as such does not warrant the attachment of any one man's name to it. The writer performs this operation in practically the same way so clearly described by Downes, except that in spreading the pyloric muscle I use the thumbs and fingers instead of artery clamps. This slight variation is not one of great importance, and though my method seems safer and less likely to damage the tissues, it is, after all, largely a matter of personal equation with the individual operator whether it should be adopted or not. This operation is as simple as it can be, accomplishes its results—namely, the relief of obstruction with the minimum of shock—and is unquestionably the operation of choice at the present time. Straus reported most excellent results from a somewhat complicated pyloroplasty. In spite of his reported excellent results his operation must be more time consuming and cause more handling of the stomach and consequent shock, and has no obvious advantage over the simpler procedure.

The anesthetic and anesthetist are important factors in the success of the operation. Whereas some years ago some difficulty was experienced in the administration of ether, recently with an anesthetist of experience in these cases, and with routine practice of introducing a catheter into the stomach during the anesthesia, no difficulty has been encountered. The operation may be done under local anesthesia, but only with difficulty, and with the probability of the infant forcing the stomach and intestines out of the wound by crying or struggling. This prolongs the operation and increases the shock. On the whole, the disadvantages to local anesthesia much outweigh the advantages, and I should entirely agree with Downes that it is not to be recommended. General ether anesthesia in the hands of an anesthetist experienced with these cases is believed to be the anesthetic of choice, the opinion of Bevan to the contrary, notwithstanding.

The factors entering into the mortality are: the general condition of the patient, the duration of the symptoms, the amount of loss in weight, the experience of the surgeon, and the attention to details in the after-care and feeding. Downes reports 175 cases with a mortality of 17.1 per cent., which is high, but probably due to delay in his receiving the patients. Any surgeon is bound to have a high mortality if the operation is too long delayed. Downes makes this clear by showing that his mortality was only 8 per cent. in cases coming to operation within four weeks of the onset of symptoms. While Goldbloom and Spence show that the mortality was under 2 per cent. in a series of 51 breast-fed babies coming to operation, with a loss of weight under 20 per cent.

At the Children's Hospital 78 pyloroplasties have been performed, with 6 deaths, a mortality of 7.6 per cent. I have personally operated on 48 patients, among whom 2 deaths occurred, a mortality of 4.1 per cent. This mortality includes deaths from any cause while the patients remained in the hospital. Of these 48 patients, 32 have been followed after leaving the hospital and 16 lost track of. Of the 32 known about, one patient who had done very well for four months died during an influenza epidemic. Three other members of the family had influenza at the time the baby became sick. The baby either died from influenza or spinal meningitis, the diagnosis made by the attending physician. The other 31 patients are all normal and healthy. Of 20 patients over a year old, the smallest weighed 17 pounds and the largest 26¼ pounds. Four patients were under 21 pounds and the rest over. The average weight at one year of the 20 patients was a fraction under 22 pounds, which is slightly above the average for a normal baby of this age according to Holt's statistics.

To sum up: Pyloric stenosis of infants is congenital in origin.

The diagnosis of the cases of marked degree offers few difficulties.

The diagnosis in the cases of mild degree is more difficult, and may be determined by the aid of the *x*-ray or the duodenal tube, or both, with more precision and less waste of time than by experimenting with feeding.

The simplest form of pyloroplasty, as described by Downes, the writer, and others, is the operation of choice. More complicated operations are not to be recommended.

General ether anesthesia facilitated by the introduction of a stomach-tube is the most satisfactory anesthetic.

The mortality is dependent largely upon the time at which operation is performed after the onset of symptoms, and may be reduced by obviating unnecessary delay.

The following up of patients after operation has showed the end-results to be as gratifying as the immediate.

CLINIC OF DR. TORR WAGNER HARMER

Massachusetts General Hospital

TENDON SURGERY

The object of tendon surgery is the restoration of function. Success in this work depends as much upon the after-care as upon the technic of operating. In the absence of an especially trained assistant the after-care demands personal supervision. Unretarded strong healing of severed tendons demands careful approximation of the severed ends by a stitch which will not destroy many tendon fibers either by transfixing or constricting, and so placed that it will not pull out with early use of the tendon. In certain situations, such as the wrist, early function is imperative in order to avoid fixation of the tendons by adhesions. The original wound and the traumatism of operation, however slight, will be followed by more or less connective tissue formation. If a suture is not sufficiently strong to endure early use, this connective tissue formation may seriously fix the tendon to surrounding tissues. The liberation of the tendon may require weeks of massage, and perhaps complete function may never be attained. The desiderata are a dependable method of suture, operative technic which minimizes trauma, immediate active use, and intelligent after-care.

Since 1909 I have employed a method of treating severed tendons which may not be new, but was not known in 1917 to a number of surgeons to whom I had spoken. Accordingly, in this year I published the method (Boston Medical and Surgical Journal, December 6th), giving in detail its application in a boy of five who had severed all the tendons on the anterior surface of the wrist. The case (Figs. 309–318) had been operated upon in 1915, three days after injury, *no splint* had been used, *active* motions had been started the day of the operation, and a per-

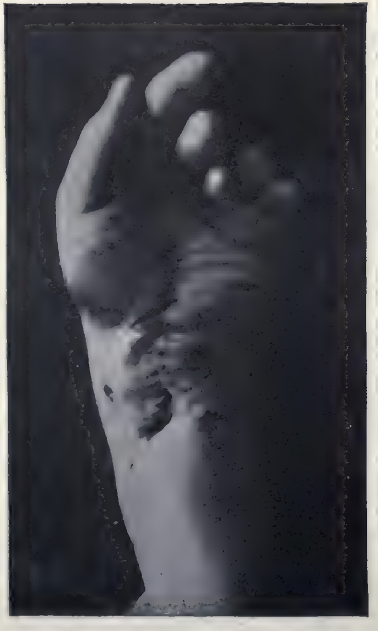

Fig. 309.

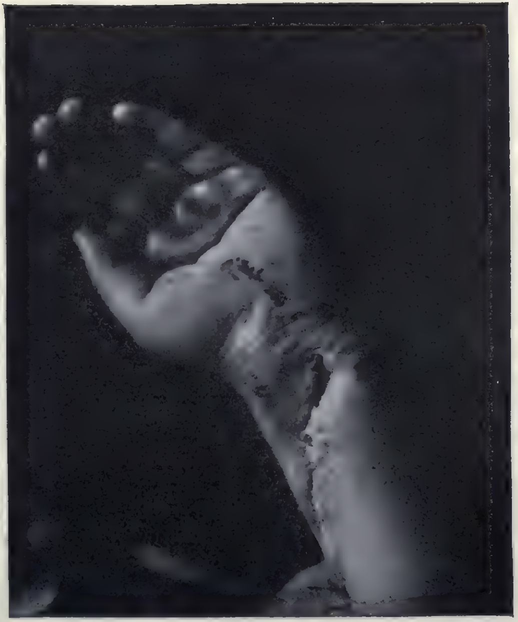

Fig. 310.

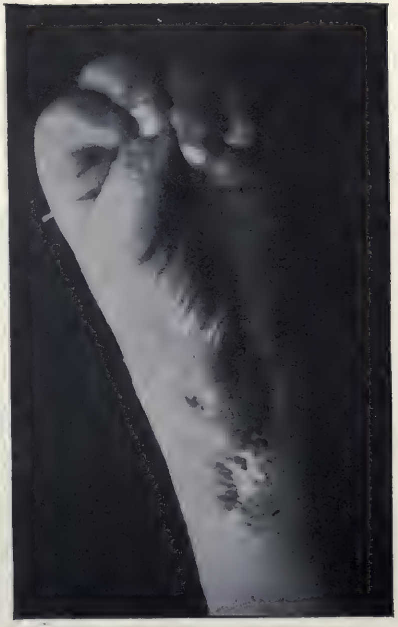

Fig. 311.

Figs. 309–318.—Suture of all tendons on the anterior surface of the wrist in a lad of five performed three days after injury (falling upon a glass bottle). Figs. 309–311 show the amount of abduction, adduction, and extension of the wrist and flexion of the fingers twenty-three days after operation. The operative extension of the wound through the annular ligament into the palm is shown.

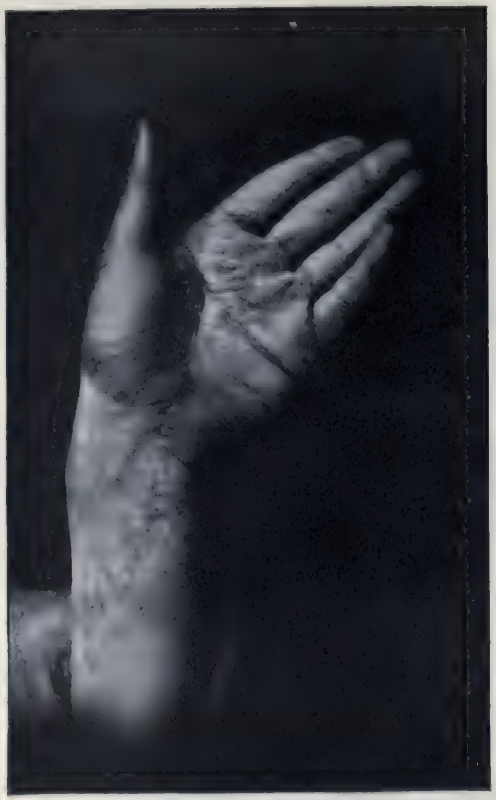

Fig. 312,

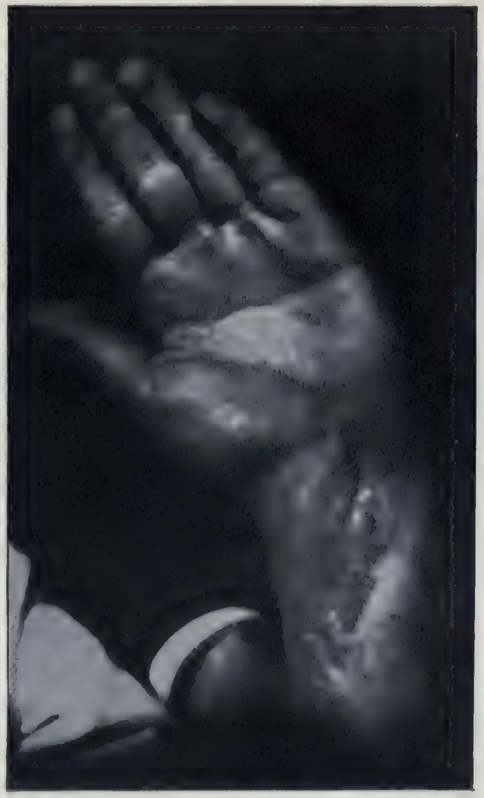

Fig. 313.

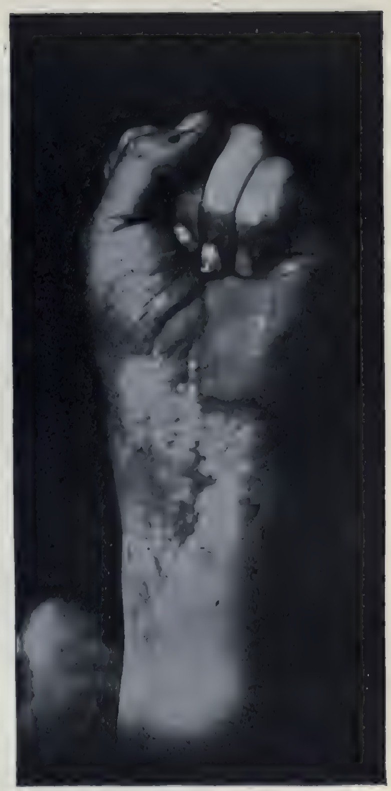

Fig. 314.

Figs. 312–316 (fifteen months after operation) show complete abduction, adduction, and extension of wrist, and complete flexion, extension, abduction, and adduction of fingers.

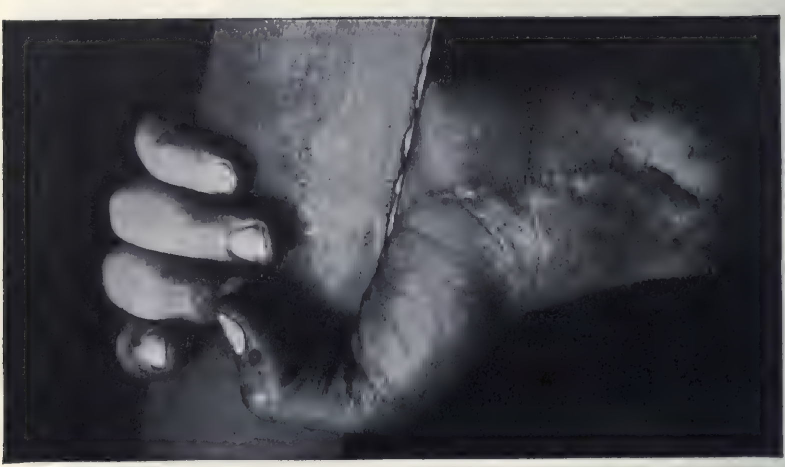

Fig. 316.

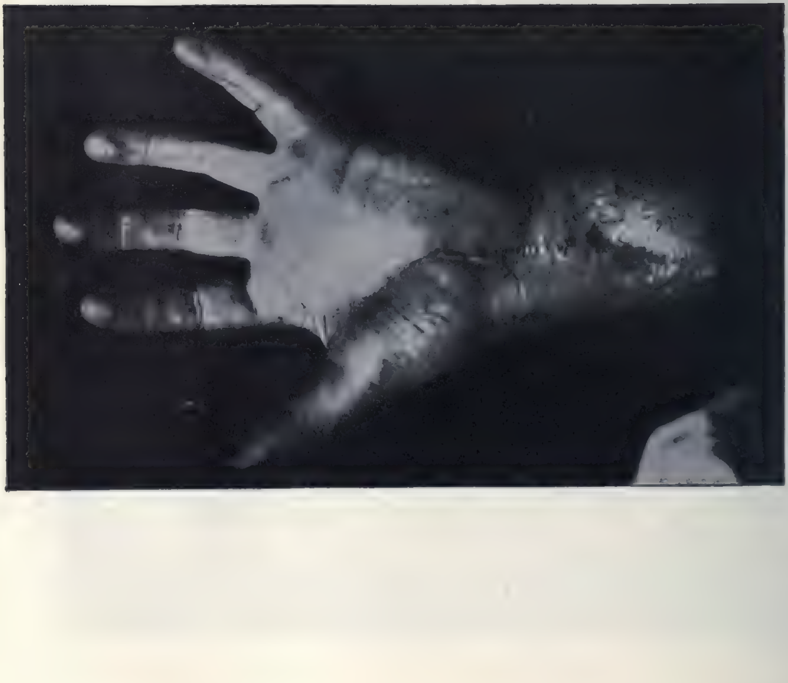

Fig. 315.

fect functional result had been obtained. Since the publication of this paper some modifications in after-care have been made, but the method of suture and the principles of technic have not been changed.

The *stitch* is of silk or fine linen, and consists of overcasting the lateral margins of both ends of the divided tendon. The overcasting is started about the width of the tendon, or a little more, back from the line of division, each loop including somewhat less than one-quarter of the diameter of the tendon. When a tendon is ready to be brought together, each end then carries two stitches and each stitch two ends, as shown in Fig. 319, *A*. In this figure, although the short ends are shown partly knotted,

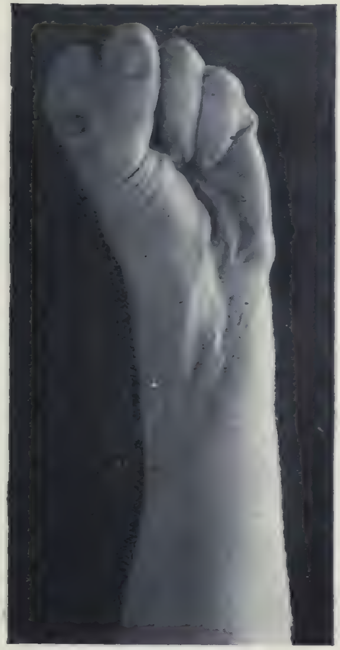

Fig. 317.

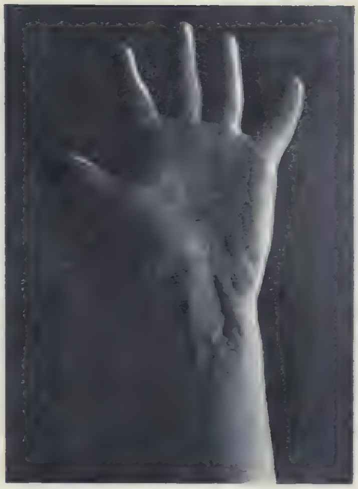

Fig. 318.

Figs. 317 and 318 (five years after operation) show complete function of the hand. There is no interference by adhesions either in flexion or extension; in fact, hyperextension of the fingers is possible.

they have been represented still threaded in the needles in order to indicate the direction in which the stitches have been placed. The full length of the long ends has not been shown in order to simplify the diagram, and the weight of the suture material has been exaggerated for clearness. If there be more than one tendon severed, stitches are placed in all before any are tied. The

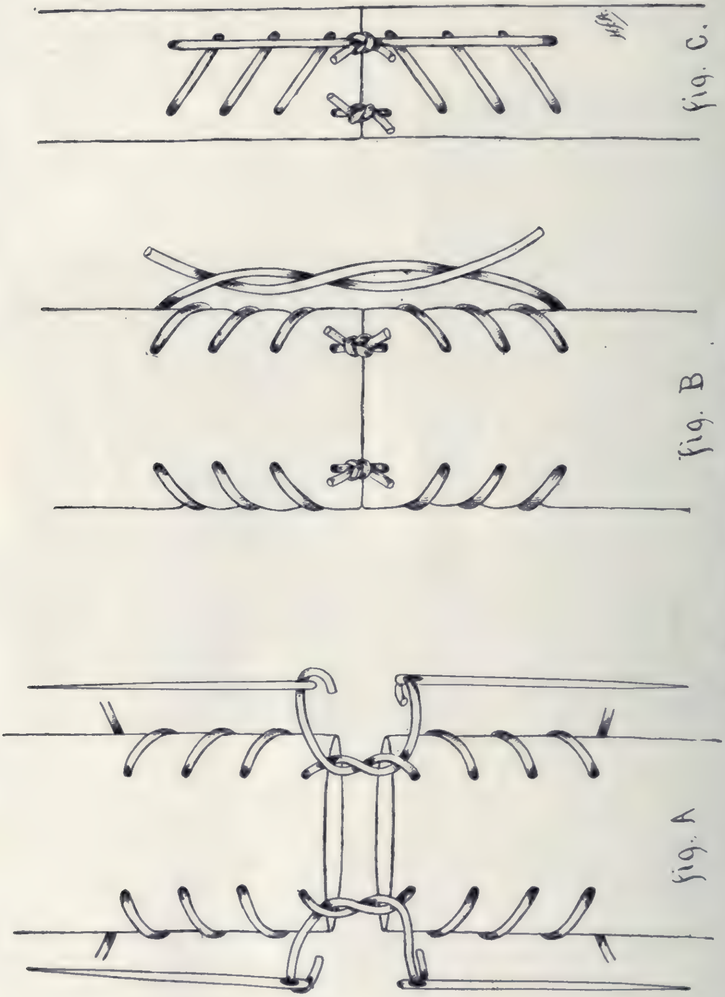

Fig. 319.—Diagram of method of suture.

assistant holds the part in an appropriate position to facilitate approximation of the tendon ends and the sutures nearest the line of division are tied. The long suture ends are then tied. In Fig. 319, *B* the constrictions of the edges of the tendon beneath the overcasting stitches are exaggerated. In this figure both pairs of short ends have been tied, one pair of long ends is being tied, and the other pair of long ends has been tied, but is out of view on the under surface of the tendon. The long ends so tied alongside the tendon serve as lateral splints. The objection that they occasion too much suture material in the wound is refuted by the fact that I have never seen any harm from them. It is likely that these lateral stays become incorporated with the sides of the tendon just as silk strands in tendon bridging. Sometimes after tying the stitch, the severed ends, although in contact, may slightly buckle. This is caused by tying the long suture ends too tightly. They should simply be made taut. The error may be readily corrected by placing a simple stitch on the anterior surface between the tendon ends. There is no tension on this simple stitch. It merely closes the gap caused by the buckling. Figure 319, *C* is a side view of a sutured tendon. It shows how the tying of the two shorter ends tends to splint the tendon on its upper surface and how tying of the two longer ends tends to splint the tendon on its under surface. The tendon shown is a well-rounded one, and consequently the overcasting includes only a part of the lateral margin. In case of a flat tendon it would include practically the whole thickness of the lateral margin.

Examination Before Operation.—A knowledge of the problem at hand should be determined before operation. This does *not* mean examination of the wound. This should be kept covered with sterile gauze. It implies quickly testing the function of the parts. This is best done by instructing the patient what you wish him to attempt and then very gently resisting the expected motion. In testing for the integrity of mixed nerves the mental attitude of the patient may render cutaneous sensation tests unreliable. In testing the integrity of the median and ulnar nerves in injuries to the anterior surface of the wrist it is unnecessary to recall that the muscles of the tendons are innervated at a higher level in the forearm. It is therefore necessary to test quickly the action of the interossei and the muscles of the thenar and hypothenar groups.

Technic of Operating.—No tourniquet is used. In extensive tendon injuries the operation is necessarily long. The protracted constriction may not only affect the nerves, but the interference with circulation may so disturb the nutrition of the parts that healing may be retarded and resistance to infection reduced. Furthermore, prolonged use of the tourniquet may be followed by postoperative oozing, which is undesirable in work of this kind. If a tourniquet has been applied to control hemorrhage, it is removed as soon as the bleeders have been secured through a wide exposure.

Iodin preparation has proved entirely satisfactory. This is fortunate because its application entails but very little disturbance of the parts. Soap and water preparation, for example, requires considerable movement of the hand, wrist, and fingers, which may cause marked retraction of severed tendons.

In recent cases with jagged wounds débridement of the wound edges with a sharp knife is done, sacrificing a minimum amount of skin and fascia. The knife, forceps, and hemostats used for the débridement are at once discarded from the operative kit. If no débridement is necessary, immediate generous exposure of the injured area is secured. For example, in case of a transverse cut on the anterior surface of the wrist in which it has been demonstrated prior to operation that the deeper tendons are injured, incisions are at once made through the annular ligament into the palm and several inches up the forearm. It is well to make incisions through the skin and deep fascia separately, because at the close of the operation these structures are to be sutured separately. Through this wide exposure the parts *in situ* are studied. Nothing is moved or disturbed until the corresponding ends of the superficial structures have been identified. The overcasting stitch of silk or fine linen is then applied to the lateral margins of these tendon ends. The four suture-ends connected with each tendon-end are clipped together in a snap as soon as applied. When all the tendon ends of the superficial layer have thus been supplied with sutures, they are turned back out of the field to expose the deeper layer. With this deeper exposure the parts are again *in situ* studied. Nothing is moved or disturbed until the corresponding ends of the structures are identified. The overcasting stitches are then applied to these tendon-ends. When all tendon-ends have thus been provided with sutures, the corresponding ends are tied together as previously described, beginning with the deepest and working toward the surface. The assistant will relieve tension on the sutures by holding the part in appropriate position.

The nerves may be accurately brought together by simple sutures which barely catch their edges, and inasmuch as no tension is to be put upon them, very fine needles and silk may be used. We wish merely to hold the nerve ends in approximation, and therefore our suture material may be very delicate and the bites of the suture very tiny. A simple suture is effective and obviates the more numerous traumatisms occasioned by manipulation during the application of a more complicated suture. It is unnecessary to state that every effort must be made to bring the nerve ends together without twisting them, so that nerve bundles may be apposed to nerve bundles as far as it lies within our power to do so. We may be aided in matching the nerve-ends by the tiny vessels upon their surfaces. Bleeding of the nerve-ends must not be checked by pressure, but the blood merely flooded or sopped away with pledgets saturated in salt solution. A little salt solution may be dripped upon the nerve as the approximation is being made to prevent the inclusion of old clot between the nerve-ends.

Whether we are dealing with tendons or nerves, we must handle them as little as possible. The tendon may be held once to apply the first stitch. When this is tied, it is used as a guy line to steady the tendon during the application of the rest of the stitch. Although the technic may be criticized, I prefer to hold the structure with a piece of moist gauze in my fingers rather than to subject it to the uncertain compression of a smooth forceps, the bite of a toothed forceps, or the tearing of tiny hooks.

After the first suture has been placed the structure can be readily handled by it rather than by the use of instruments. I am strongly opposed to any instrument which compresses the structure during the application of the stitch or during the apposition of the ends in tying together. If no nerves have been sutured, it is well to test the strength of the tendon sutures by slowly and gently flexing or extending the part before closing the fascia interruptedly with fine linen or silk. Small bleeders in the subcutaneous tissue will by this time be thrombosed. If any need be tied it may be done with No. 00 plain catgut. The skin is closed interruptedly with fine silkworm-gut. No drainage of any kind is used, not even strands of silkworm-gut. A light dry dressing and a splint which fulfils the criteria to be described are applied.

In recent cases the tendon or nerve ends may be frayed. In old healed cases the tendon or nerve ends are involved in scar tissue. In both instances the ends require preparation for suture; in the first instance to expose undamaged tissue, and in the second to expose normal tendon or nerve structure. In either instance this is to be accomplished by clean-cut cross-sectioning with a sharp knife. Scissors traumatize the structures by crushing them.

It is unfortunate that any suture material need be used. Inasmuch as this is an unavoidable necessity, let the material be as fine as possible and as small in amount as possible. It always acts as a foreign body and provokes tissue reaction. That this tissue reaction does not result in adhesions which limit the movement of the tendons, early use of the parts is imperative. That connective tissue develops about the sutures we cannot avoid, but that this connective tissue become adherent to surrounding structures we can avoid by early motion. Inasmuch as we cannot prevent the formation of connective tissue about suture material, and inasmuch as we can prevent its adherence to surrounding tissues by early motion, it is wise that the suture material be applied as much as possible to the external surfaces of the tendons. Any knots which lie between the approximated ends, or any sutures which pass through the severed ends are objectionable as foreign bodies which thwart normal repair. Scar tissue between tendon ends will not endure early motion without stretching. I have observed a gap occasioned by injudicious *passive* motion of recently united tendons bridged by scar tissue. In old healed cases in a number of instances I have observed gaps between tendon ends bridged by scar tissue. This must all be removed, for it tends to stretch. One instance where there were two long gaps so bridged by scar, rather than graft, I fashioned the scar tissue after separating it from surrounding tissues, excised redundant portions, united as usual, and then reinforced the scar tissue edges with a fine overcasting stitch of silk. It looked very pretty. No splint was used. Active motion was started at once. It worked well, but only for a very short time; not because the sutures pulled out, not because the structures became adherent, but because the scar tissue bridges very soon stretched and loss of motion over very considerable arcs resulted. It is important, then, to have *nothing between the tendon ends and to have them snugly approximated.*

The *surgery of old healed cases* may demand considerable ingenuity and some knowledge of the behavior of tendon, skin, and bone-grafts. I have advisedly not mentioned the grafting of nerves because defects in their continuity may usually be connected by direct end-to-end suture after adequately freeing up the nerve and holding the parts in the most relaxed position. This can usually be accomplished and is preferable to the introduction of tissue tunnels or sleeves to encourage the direction of the regenerating fibers.

Recent cases with mangled, dirty wounds must be treated like any septic wound, with special attention to the prevention of contractures and joint ankyloses. The case then falls into the category of old healed cases, but is in better condition for reconstructive operating than the usual neglected cases. At an appropriate stage in the granulating of large septic wounds it may be better judgment to cover with a pedicle flap, for example, from abdominal wall to back of hand. This will prevent the formation of thin firmly adherent new skin which usually has to be sacrificed at any subsequent operation because it is impossible to turn it back as a viable flap.

In case of considerable loss of tendon, transplantation may be resorted to to avoid grafting of fascia or excised tendon (cf. palmaris longus). For example, the proximal parts of the sublimis tendons of the palm may be united to distal parts of the profundus tendons or proximal parts of the extensor ossi metacarpi pollicis, extensor brevis pollicis, or extensor carpi radialis longior may be united to the distal part of the extensor longus pollicis, etc. The technic of suture, however, differs in no way from that of traumatically severed tendons. The freeing up and shaping of scar tissue with which nature has attempted to repair a gap is not reliable as previously cited. Defects of considerable length, such as may occur in mangling accidents of the hand, may be filled by the use of grafts of fascia or excised tendon. Fascia may be secured from the iliotibial band. Tendon may be secured by excising the palmaris longus. The plantaris would be ideal, but we have no way of previously demonstrating its presence. There may be injuries to bones. This may be in the form of defects requiring bone-grafts or in the form of exuberant callus or spurs which already deflect the course of adherent tendons or would deflect the course of tendon transplants. I have encountered one case (Figs. 328–330) in which untoward new bone formation following old compound fractures of the metacarpals held the extensor tendons of the index-finger fixed and distorted. After freeing the tendon from this "rocky bed" it was found to be too long. The bony overgrowths were removed and the tendon shortened. Figure 330 shows that complete extension of this finger cannot be accomplished. There is a little too much slack in the tendon. Further shortening at the time of operation would have been desirable. The fingers had been held in flexion for eight years. The result is a great improvement, but not perfect. The difficulty of exactly estimating the length of a tendon, be it shortened, or lengthened, or grafted, is well known to all who have worked in this field.

Figures 331–333 illustrate a case in which defects of the extensors of the second and third fingers from the wrist to the knuckles were bridged by sections of the palmaris longus of the same arm. These grafts were carried through tunnels in the fat of a free skin-and-fat transplant from the abdomen to the back of the hand. The fourth and fifth extensors were merely freed from scar tissue. After operation marked flexion of the fingers and wrist were restricted by a splint, but active extension was permitted from the beginning. Most of the fat of the graft melted away and a considerable portion of the skin became gangrenous and separated. However, the tendon grafts lived, and as the figures show there is now present complete flexion of all fingers, complete extension of the second, fourth and fifth, and almost complete extension of the third. Extension of the third finger is not quite complete because the length of the tendon graft from the palmaris longus was not properly estimated at the time of operation. The graft was a little too long, and in consequence there is now a little slack which prevents extreme extension. The injury was a mangling accident some months prior to operation, and all the fingers had been held in semiflexion, prevented from complete flexion by scar tissue on the back of the hand, and from complete extension in part by extensive loss of tendon and in part by anchoring scar.

Small tendon defects, especially in the region of the distal phalanges, may be nicely bridged by a number of silk strands. The most gratifying result of this type was in an academy student. Through a rectangular flap of skin embracing the distal and middle phalanges of the ring finger with a pedicle along the ulnar side, the profundus tendon with a considerable gap across the distal joint was exposed. This was bridged with silk strands, and next season the student resumed playing both baseball and football. These small problems about the terminal phalanges are often quite as perplexing and their successful solution quite as gratifying as more serious injuries.

Splinting and After-care.—The after-care is quite as important as the operation. With a reliable method of suture success depends chiefly upon immediate active motion to prevent anchoring adhesions. No splint which limits active motions of the sutured tendons should be used. In many cases no splints are necessary, and this was my practice until recently in all cases uncomplicated by nerve suture. Two accidents have demonstrated the prudence of restricting the pull of opposing muscles in vigorous, energetic individuals. In one instance drawing up the bedclothes during sleep pulled asunder one of two extensor tendons sutured that day. Active motion of both tendons had been present in the evening, but was discovered absent in one on waking in the morning. Had too forcible flexion of the fingers been prevented by splinting, this accident would not have occurred. Resuture was necessary and, fortunately, was entirely successful. In case the flexor tendons at the wrist have been united, it is well to limit *extension* of the phalanges and carpus. The splint, however, should in no way restrict *flexion* of the phalanges and carpus. This may be conveniently accomplished by a posterior gutter splint of aluminum extending from the fingers up the forearm, bent at the wrist to maintain slight flexion, padded with felt, and held in place by webbing buckle straps attached to the splint. The straps about the forearm and above the wrist may be snugly buckled, but the strap across the palm only loosely applied in order to permit slight flexion at the wrist. There should be no strap across the fingers. In case such a splint is not at hand, a device may be readily improvised consisting of a straight posterior splint of wood with the portion distal to the wrist built up with folded towels secured to the splint by adhesive straps.

Active use of united tendons begun as soon as the patient has recovered consciousness from the anesthetic will *not* pull out a dependable suture. Overvigorous pull of opposing muscles may partially separate united tendons. Passive motion must be forbidden for twelve to fourteen days. No person will use a sutured tendon too vigorously. A few persons will use the opposing muscles too vigorously. Restriction of the activity of the sutured tendons is, therefore, not only unnecessary, but undesirable. Partial restriction of the use of the opposing muscles is therefore wise for a week or ten days. On the same day as the operation the patient is encouraged to use actively the sutured tendons, and the opposing muscles gently within the scope permitted by the splint, and is forbidden to use passive motion. The dressing is rapidly reduced in bulk during the next few days so as not to interfere with motion. In a day or two the motions executed by the sutured tendons are performed passively to permit the patient to see the amount of motion that can be safely accomplished. The motions executed by the tendons of the opposing muscles may be passively performed with great gentleness. I do not delegate this passive motion to anybody for ten or twelve days. The patient and those in attendance are enjoined not to do so. Within seven to ten days the splint may be omitted. In twelve or fourteen days the services of a mechanotherapeutist are started (massage and gentle passive motion in both directions). With active function of the sutured tendons from the beginning it is surprising with what rapidity the tendons resume their strength. The intelligent co-operation of both masseur and patient is at this time of extreme importance.

In cases in which nerve suture has also been necessary, some device to prevent tension on the nerve must be worn, day and night, for six or eight weeks. In case of suture of the nerves at the wrist this may be conveniently accomplished by the use of an aluminum gutter splint, as previously described, extending from the knuckles half-way up the posterior aspect of the forearm, bent at the wrist to maintain slight flexion, padded with felt, and held in position by webbing buckle straps attached to the splint. A splint of this type is light, not cumbersome, and readily removed and applied. This facilitates the services of the mechanotherapeutist. When removed by the masseur, both he and the patient must understand that the fingers may be extended and flexed, and the wrist may be flexed, but the wrist must not be extended either actively or passively beyond the point which is possible when the splint is in place.

Critical examination of the cases illustrated by the accompanying figures will demonstrate, I believe, the importance of very early active function. It will demonstrate also, I believe, the reliability of this stitch, one which may be depended upon to tolerate early function, and thus obviate in a great measure the formation of adhesions. The identification of tendons, the minimizing of operative traumatism, the preservation of grooves or gutters of tissue about which tendons working at an angle may play, the use of skin, fat, fascia and bone, make this one of the most practical and fascinating fields of surgery. I trust that the method above described may meet favor in other hands: no tourniquet, the overcasting stitch, dry wound, separate closure of fascia, and no restriction of immediate active function of the severed tendons.

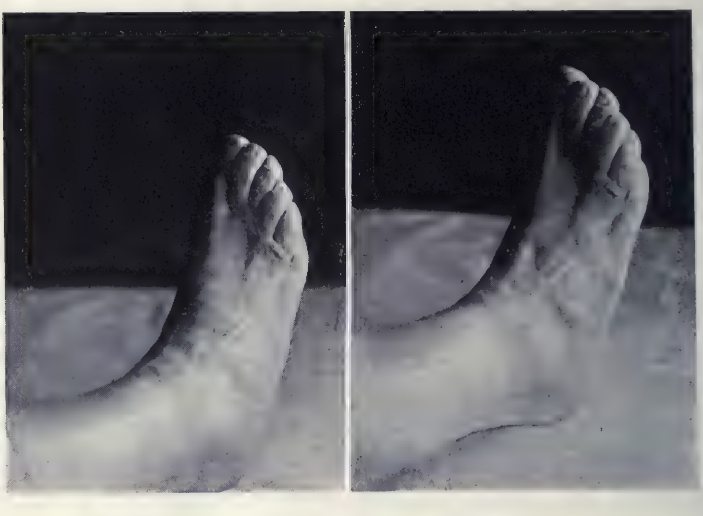

Fig. 320.—Foot in repose. Fig. 321.—Toes in extension.

Figs. 320, 321 (eleven months after operation).—Suture of extensor tendons of fourth and fifth toes performed immediately after injury by lacerated wound by axe opening the metatarsophalangeal joint and fracturing the phalanx. Suture and immediate closure without drainage followed by infection necessitating opening the outer two-thirds of the wound. Wound healed by granulation without damage to sutured tendons. (Mass. General Hosp. Records, E. S. 236,527.)

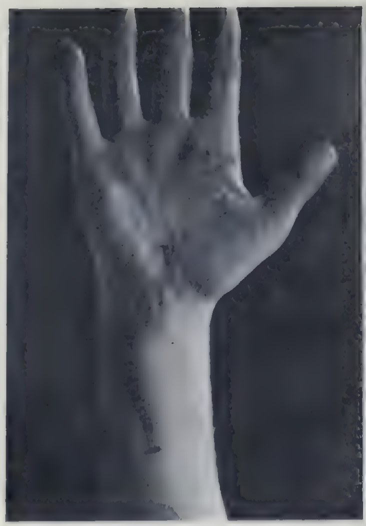

Fig.322 shows extension and action of interossei.

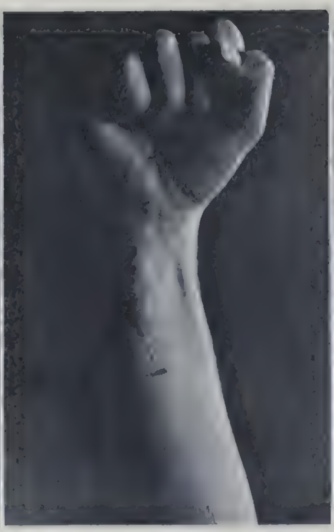

Fig. 323 shows flexion of fingers.

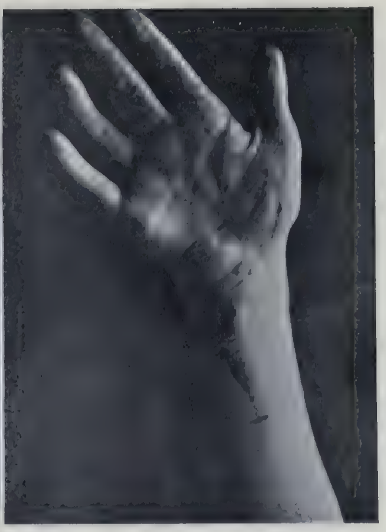

Fig. 324 shows adduction at wrist and extension.

Figs. 322–326.—Suture of median and ulnar nerves, flexor carpi ulnaris, all of profundus, two of sublimis, and palmaris longus tendons, performed twenty-four hours after injury (thrusting arm through a pane of glass). Pictures taken five months after operation. (Mass. General Hosp. Records, E. S., Vol. 1493, p. 51.)

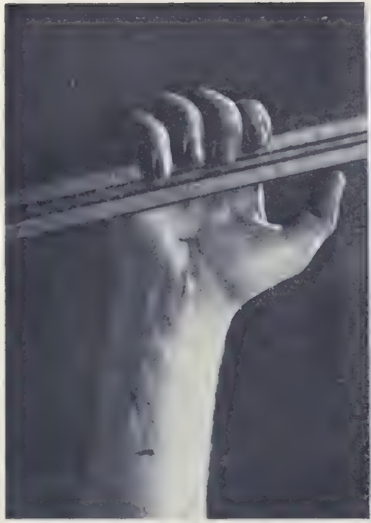

Fig. 325.

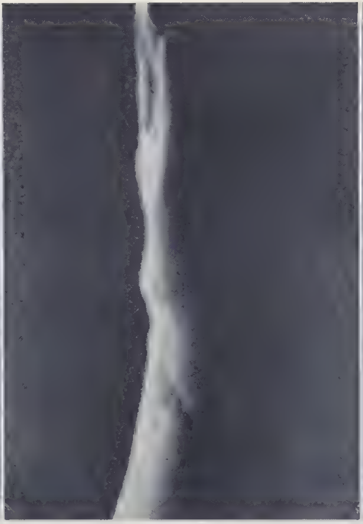

Fig. 326.

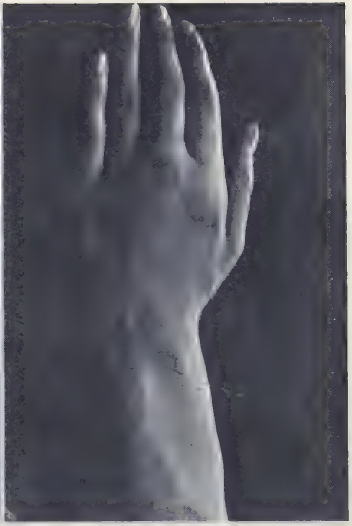

Fig. 327.

Fig. 325 shows action of profundus tendons.

Fig. 326 shows extension of fingers, indicating slight limitation in extension of ring-finger. Also shows how far laterally the wound extends.

Fig. 327.—Suture of extensor tendons of second and third fingers performed a few hours after injury (skiving blow with an axe, opening the third metacarpophalangeal joint, and nearly sectioning the second metacarpal bone). Picture taken one month after operation. Shows some limitation in extension of fingers owing to stiffness from injury to bone and joint. (Mass. General Hosp. Records, E. S., 241,953.)

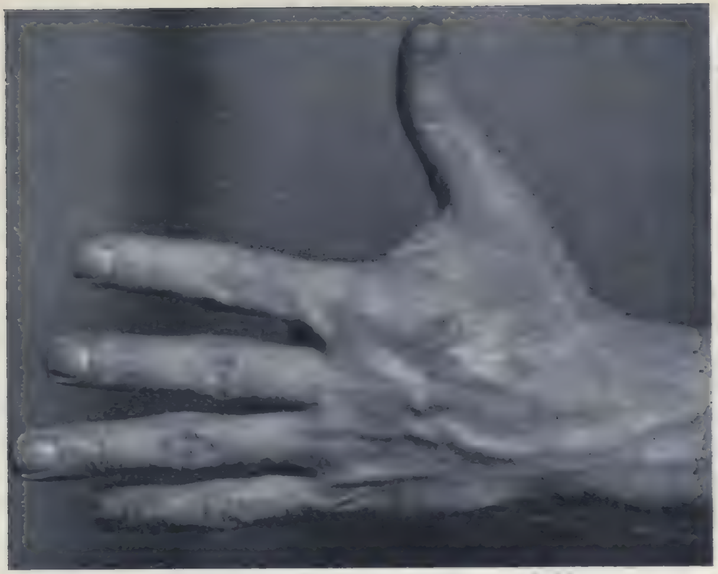

Fig. 328.

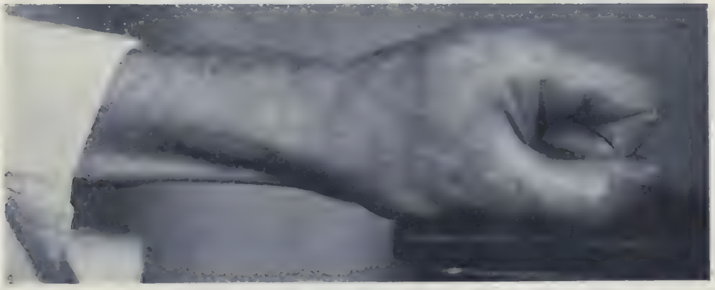

Fig. 329.

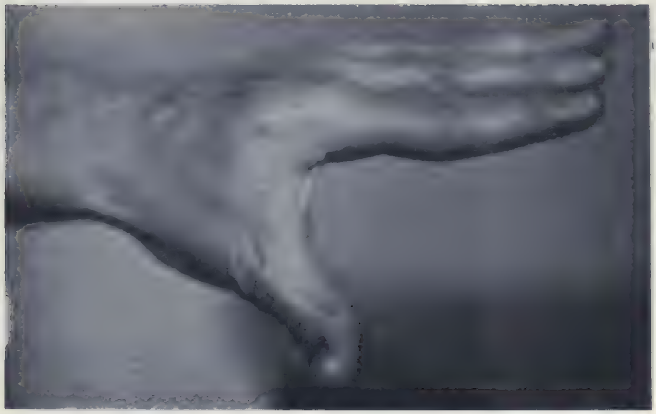

Fig. 330 shows some limitation in extension of forefinger due to a little too much slack in the tendon. Further shortening at time of operation would have been desirable.

Figs. 328–330.—Old compound fractures of metacarpals with severed extensor tendons. Shortening of extensors of second finger and suture of extensor of third finger performed eight years after injury (compound fractures of second and third metacarpals from crush in gears of wind-mill). Since this time the second and third fingers had been carried in flexion. Pictures taken ten months after operation. Tendons found buried in scar tissue and adherent to metacarpals. Impossible to distinguish between extensor communis and extensor indicis. Both fused in scar adherent to bone and distorted by exostoses. Exostoses removed, tendon shortened. Tendon ends of third finger liberated from scar and sutured.

Figs. 331–333.—Grafting of palmaris longus tendon to fill defects in extensor tendons of second and third fingers from knuckles to wrist, performed several months after injury (mangling accident). Fingers had been carried in flexion. No power of extension in second and third and very slight in fourth and fifth. Pictures taken thirteen months after operation. Thin glossy adherent skin removed from greater part of dorsum of hand. Extensor tendons of second and third fingers found missing through full length of metacarpals. Extensors of fourth and fifth fingers freed from scar tissue. Grafts from palmaris longus were run through tunnels of fat in a free skin-and-fat graft from the abdomen. Most of the fat melted away. Considerable portion of skin became gangrenous and separated. Tendon grafts, however, not affected. (Mass. General Hosp. Records, E. S. 235490.)

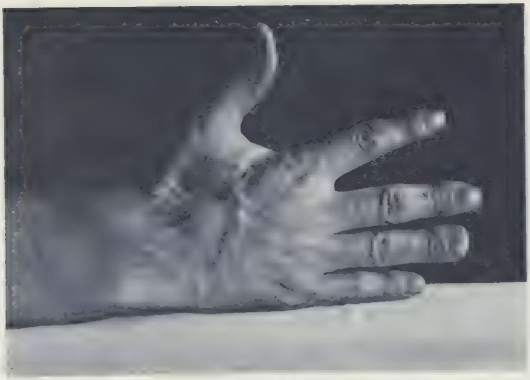

Fig. 331.

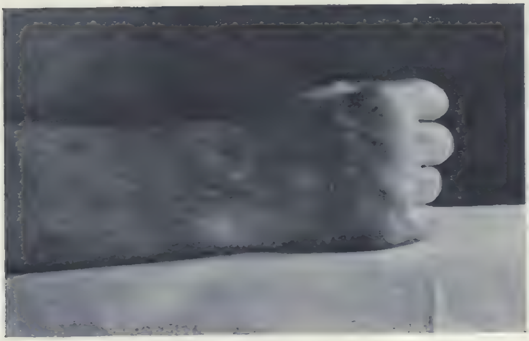

Fig. 332.

Figs. 331 and 332 show extension and flexion of fingers.

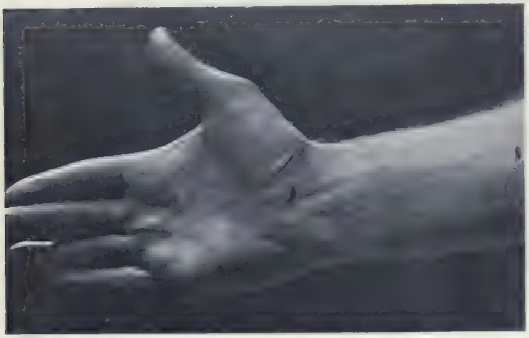

Fig. 333 shows incision for removal of palmaris longus.

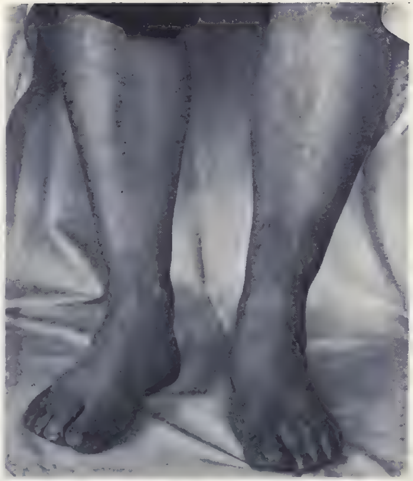

Fig. 334.

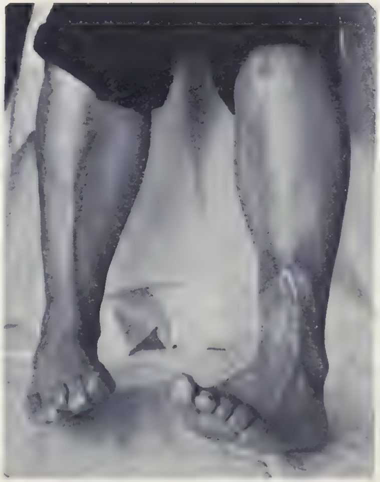

Fig. 335.

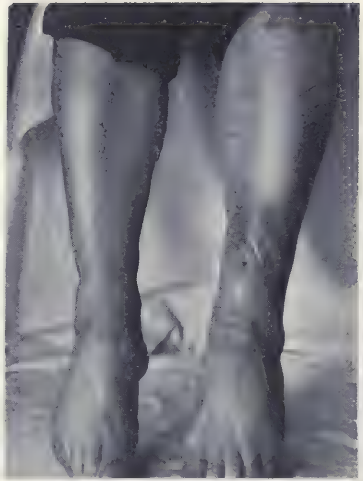

Fig. 336.

Figs. 334–336.—Suture of tibialis anticus performed a few hours after injury (cut with heel of axe). Pictures taken seven months after injury. At operation tibialis anticus found severed, extensor longus hallucis nicked and bone indented. Suture of tibialis anticus tendon. Patient a well-known amateur skater. Skating two and one-half months after injury, and could not distinguish any difference between action of two feet. Fig. 335 shows action of severed tendon. Also illustrates some adhesion at upper angle of wound. Fig. 336 shows extension of feet.

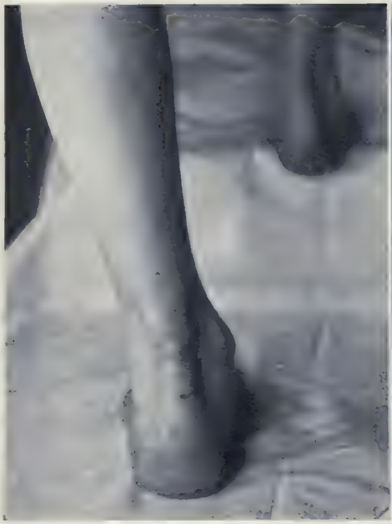

Fig. 337.

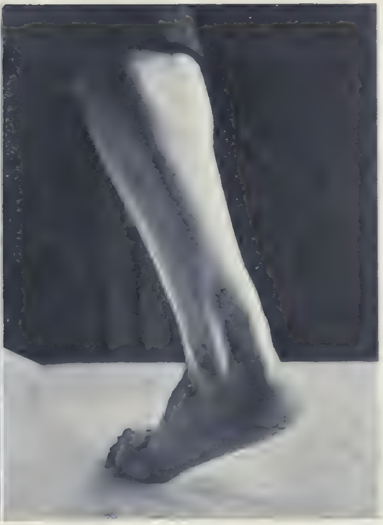

Fig. 338.

Fig. 337.—Suture of tendo achillis performed several hours after accident (cut by breaking of plate glass window). Pictures taken five months after operation. (Mass. General Hosp. Records, E. S., Vol. 1496, p. 53.)

Fig. 338 shows use of gastrocnemius and soleus in balancing the entire weight of the body on the toes of one foot.

CLINIC OF DRS. J. DELLINGER BARNEY, CHARLES A. WILLIAMS, WILLIAM M. SHEDDEN, AND EDWARD S. WELLES

From the Genito-Urinary Service, Massachusetts General Hospital

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THE PROBLEM OF RENAL CALCULUS WITH SPECIAL REFERENCE TO TREATMENT

Although the question of renal calculus would appear to have been thoroughly discussed from every angle, the diagnosis and treatment has not yet reached a point of perfection.

The impression is wide-spread that modern diagnostic methods and apparatus are able not only to indicate whether a stone is present but also the number of stones and their size and location. With improvement in surgical technic it would appear to be a simple matter to extract from a comparatively small cavity every particle of calcareous deposit which it contains. Investigation along these lines shows that the contrary is often the case, and whereas this is true in the majority of instances, there are many exceptions, the sum total of which counts up with uncomfortable rapidity.

The most valuable opinion is that which is based upon one's personal experience or upon the work of others with which he is thoroughly familiar. It has, therefore, seemed valuable to review our experience with the problem of renal calculi in the Genito-urinary Service of the Massachusetts General Hospital.

Our records contain 139 cases of renal calculus so proved by operation or otherwise. Many other cases have been admitted with this diagnosis, but sufficient evidence was not at hand in these patients to make the diagnosis undoubted, and they have not been included in this study. A brief review of some of the data in these cases seems worth while.

There were 108 males and 31 females, showing a definite predisposition for stone on the part of the male. Youth and old age, on the whole, are immune from this ailment, and one has, therefore, to deal in most cases with an individual in the prime of life. Our youngest patient was ten years of age; our oldest, seventy years. There were 15 patients between the ages of eleven and twenty, 44 between twenty-one and thirty, 39 between thirty-one and forty, 29 between forty-one and fifty, and 11 patients past fifty years of age.

It is interesting to note how long a time may elapse from the date of the first symptom until the time when the patient seeks relief, a point which would indicate comparative silence on the part of the stone. Furthermore, although some of our patients had sought professional advice before coming to the hospital, the stone was entirely overlooked in many, and the symptoms assigned to a lesion elsewhere than in the urinary tract. In a previous communication (Internat. Jour. of Surg., December 1, 1918) one of us (J. D. B.) made the observation that in "290 of our hospital and private cases, 53, or 18 per cent., had had one or more previous operations, mostly (36) on the appendix, but including almost every other abdominal organ as well." In the present series of cases 7 had had previous abdominal operations (of which 5 were for the removal of a supposedly diseased appendix) without relief of symptoms, the actual source of trouble lying in the kidney. To quote again from the article previously referred to, "The only reason for the error which the study of these records has brought to light is that in most cases no use whatever was made of the available and well-tried diagnostic measures, the surgeon relying largely upon what he could himself feel or see, or taking the evidence presented by his underlings. We have all seen right-sided calculi with high temperature, pain, tenderness, distention, nausea and vomiting, leukocytosis, and other symptoms characteristic of an acute appendicitis or other abdominal condition, and we may well forgive the surgeon who, with this picture before him, perhaps in the middle of the night, and without facilities for differential diagnosis at hand, gives the patient the benefit of the doubt and operates in the belief that he is forestalling a gangrenous appendix or a general peritonitis. Should he prove to be wrong it is an ungrateful patient indeed who would not hold him guiltless.

"But when it comes to the milder conditions, or to symptoms which have dragged along for a number of years, there is far less excuse for a mistaken diagnosis, and he who falls into the trap without having resorted to every diagnostic measure has only himself to blame. There are, nevertheless, certain cases of urinary calculi, some of the kidney, but more of the ureter, which defy every effort at diagnosis, and an operation for a supposed stone may yield negative results or an entirely different diagnosis will be made. That the symptomatology of urinary calculi is not always classical has been shown by Cabot, who, in a series of 127 cases, found a persistently negative *x*-ray in 6 per cent., and in 150 cases a persistently normal urine in 14 per cent. This evidence is corroborated by Braasch in his analysis of 294 cases of ureteral stone. The *x*-ray was negative in 11 per cent., while the urine was entirely normal in 12 per cent., contained only an occasional red cell in 9 per cent., and only a rare pus-cell in nearly 3 per cent. A review of the situation both by an examination of our own records and a study of the literature convinces me that in spite of great advances in diagnosis a certain number of cases will continue to be operated upon for stone in the presence of a suspicious shadow, and perhaps an equal number, who actually have a calculus, will undergo operations for other conditions. Braasch reports 5 cases in the first category, and I feel sure we could collect as many more were the facts investigated."

The duration of symptoms was less than a week in 4 cases and under two weeks in 3 others. Nine patients had had their troubles for two months, 18 for six months, and 8 for a year. Surprisingly enough the symptoms had lasted for three years in 39 cases, for five years in 11 cases, for ten years in 14 cases, and over ten years in 17 cases. The most long-suffering patient had fought off the inevitable for twenty-five years. All of which goes to show that renal calculus may be insidious in its

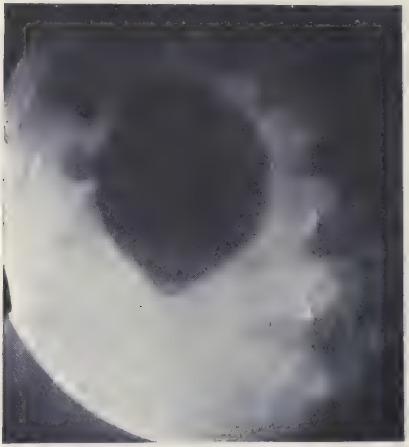

Fig. 339.—Unusually large left renal calculus, with one or two smaller stones occupying lower calices and pelvis of kidney. Stone easily palpated through abdominal wall. Kidney very movable, not adherent. Pain very slight, amounting to only a dull ache, and appeared only two or three months before operation.

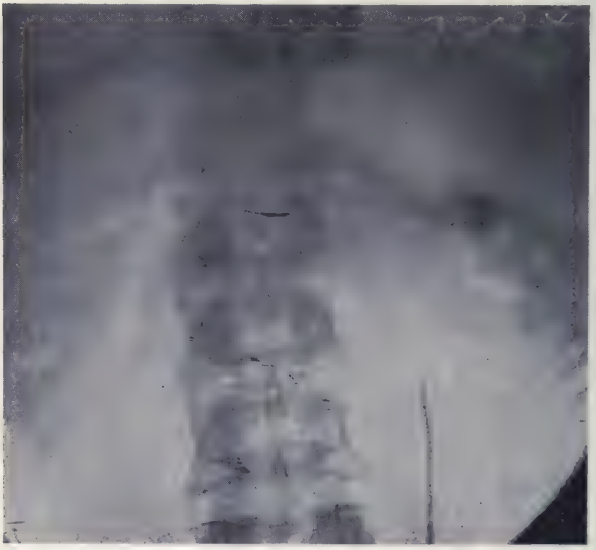

Fig. 340.—Single silent calculus. Pain consistently on the opposite side.

onset. Generally speaking, the smallest stones gave rise to the most severe and frequent attacks of pain, leaving the task of undermining a patient's general condition by the production of pyonephrosis to large or multiple calculi.

Although it is commonly known that calculi may be "silent" either throughout their entire residence in a kidney, or for a very long period of time (Figs. 339–341), the production of pain is their habit, and it is pain which forces the patient to seek relief in most instances. In 112 of our cases pain was the first symptom noted—"dull" in 47, "sharp" in 62. While we have seen an occasional example of pain in the region of the opposite kidney (Figs. 340, 341), this symptom usually arises on the affected side, remaining in or about the region of the kidney, or, quite as often, radiating downward toward the groin. When so situated on the right side, and when accompanied, as it frequently is, with nausea and vomiting, pyrexia,

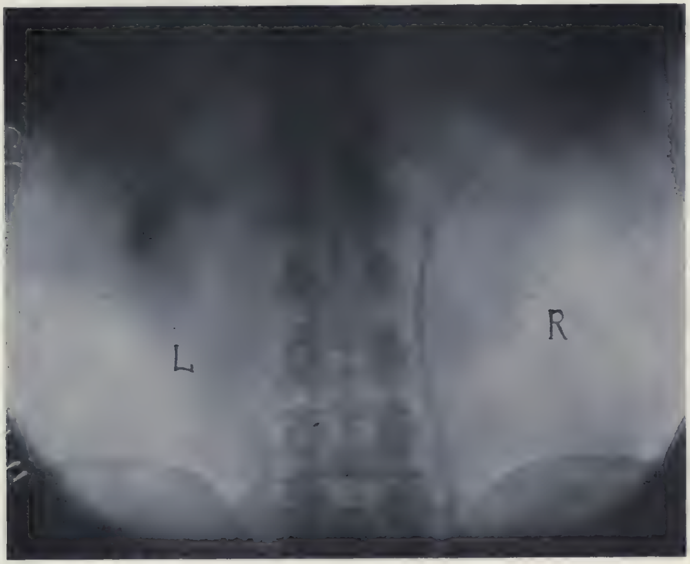

Fig. 341.—Multiple stones in left kidney. Shadow suggests but one stone. Pain entirely on the right side. One large stone removed through pyelotomy incision, on others felt. (See Fig. 342.)

leukocytosis, and local tenderness, the most careful surgeon even after exercising every precaution against error may find himself operating upon a normal appendix.

In 31 patients the first indication of a lesion in the urinary tract came from other directions than the kidney. Hematuria first caught the patient's attention in 10 instances, dysuria, in 5; the onset of "chills and fever" of unexplained origin drove 5 patients to the hospital, while pyuria was the deciding factor in 4, frequency of urination in 3, retention of urine in 2. An unduly urgent desire to urinate caused 1 patient to seek relief, whereas the spontaneous passage of a stone sent another patient to the hospital, where other calculi were found to be still in the kidney.

Unusual frequency of urination was complained of by 43 patients, a phenomenon which may be ascribed to the irritability of the bladder neck by the passage over it of an infected urine.

While it is not believed that a "housewife" has a dangerous occupation, 23 of our patients were so occupied, shoemakers, clerks, machinists, laborers, carpenters, and students coming next in the order named. Almost every other known activity was represented by one or more patients. The question of occupation is touched upon simply to show the wide variety of the classes of people who are afflicted with renal calculi.

The great majority of cases had no appreciable amount of temperature at the time of admission to the hospital. In 44 it was normal, in 60 it was as high as 99° F., while in 21 there was a temperature of from 99° to 100° F.

Pus is the most frequent finding in the sediment, as our records show it was present alone 59 times, and combined with blood 41 times, a total of 100 cases. Blood alone, generally microscopic, was found in 26 cases. Reference has already been made to the fact that in studies of renal and ureteral calculi by Cabot and by Braasch the urine was repeatedly negative in a considerable number of instances. In substantiation of this point we may say that in 12 of our cases, or 8.6 per cent., the urine was persistently negative. We feel that too much stress cannot be laid on this experience, as it may and often does mislead the unwary into the belief that renal calculus cannot be present.

Tenderness of or in the region of the stone-bearing kidney was noted in 60 instances, and this organ was recorded as "palpable" 19 times. It should be recalled, however, that kidneys are frequently palpable, especially in women, and particularly on the right side, in normal, healthy individuals, so that too much emphasis should not be placed upon this finding. In one instance (Fig. 339) an unusually large renal stone occurring in a thin individual was readily palpated through the abdominal wall.

Roentgenograms of the urinary tract showed the presence of stone in 125 cases, and by this or other methods stones were found not only in the kidney but also in the bladder in 8 cases and in the ureter in 2. In one or two cases where the x-ray findings were negative, but where the persistence and character of both objective and subjective symptoms indicated the probability of stone, operation was performed and a calculus found and removed. One case is of special interest. He was a man of thirty-five who had been seen off and on in the out-patient clinic for about two years with intermittent attacks of right-sided pain, accompanied by a rise of temperature, nausea and vomiting, and tenderness in the costovertebral angle. The urine of the right kidney always, but more especially after an attack of renal colic, contained pus in considerable amount, together with microscopic blood. A pyelogram on several occasions showed what was considered a normal pelvis (Fig. 344) both as regards size and shape, and the calices were not demonstrably dilated. Still more frequent roentgenograms of the urinary tract showed no evidence of stone. We regard these observations as of special interest and importance, as during this long period of time the conditions both inside and outside the patient's body were necessarily different and different radiologists took the plates. Operation was finally performed by one of us (J. D. B.). The kidney and ureter were not abnormal in appearance. On opening the pelvis the probe at once located a stone, which after being extracted with some difficulty proved to be like a piece of clam shell and about 2 x 1 cm. in diameter. Chemically, the stone proved to be uric acid mixed with a small amount of calcium oxalate. Subsequent experiments with this calculus showed that it was impossible to conceal it from the *x*-ray regardless of the medium in which it was placed.

C. H. Mayo (Mayo Clinics, 1919, xi) wisely remarks that "more careful search must be made for extra stones, since superimposed stones may give but one shadow." In this opinion we are in complete accord, as it has been a not infrequent experience in this series of cases (Figs. 341–343, 345–348). The importance of appreciating this possibility cannot be overemphasized not only during the operation, but during convalescence and subsequently. It has an important bearing upon the question of recurrence, a subject with which we shall deal forthwith.

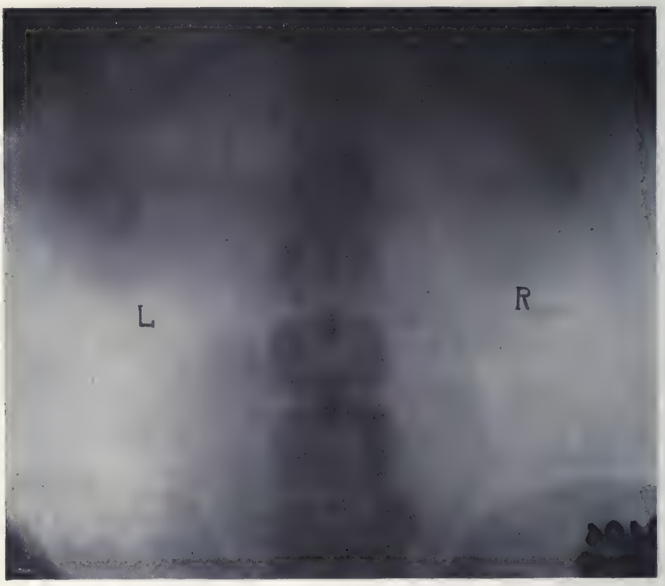

Fig. 342.—Same patient as in Fig. 340, taken during convalescence. Shows shadows of two or three more stones, not detected during operation. (See Fig. 343.)

While our cystoscopic findings have not been adequately recorded, it was none the less found that pus was present in the urine of the affected side in 39 cases, while in 10 instances only red blood-cells were present at the time of the examination.

In this connection it is interesting to note that the phenolsulphonephthalein test of the urine from the stone-bearing kidney was extraordinarily low in many instances. It was less than 20 per cent. in 28 cases, of which in 10 it was too low to be measured at all, and was recorded as practically zero. In 4 cases of bilateral renal calculi the total renal function was 10 per cent. in 2, 20 per cent. in 1, and greater than this in another (Fig. 349). Furthermore, it has been a not infrequent experience to find an alarmingly low test on the healthy side, but in the belief that the activity of this kidney was embarrassed by disease in its mate we have not hesitated to operate. In almost every instance a subsequent test of the bladder or

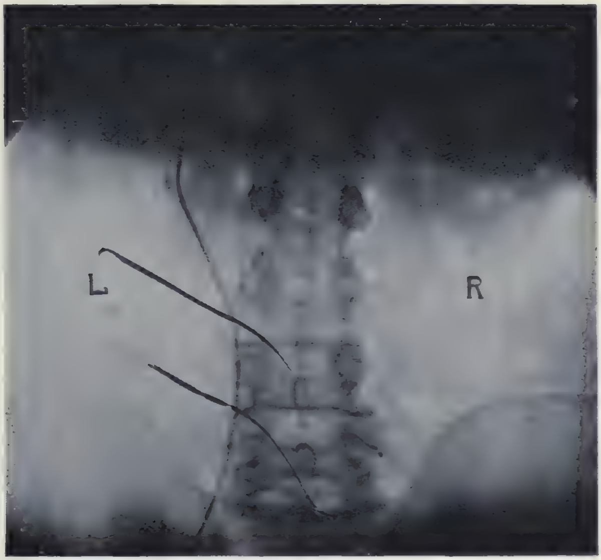

Fig. 343.—Same case as in Figs. 341, 342, taken a year later. Patient meantime passed two or three stones. One is now shown in the ureteropelvic junction evidently trying to escape. Since this plate was taken the stone has moved down to a point opposite the iliac crest.

of the divided urines has shown a marked rise in the output of the drug.

It has already been shown that whereas the urine of the stone-bearing kidney is generally infected, it is also a fact that the urine is uninfected in a considerable number. This freedom from infection has been found not only in unilateral, but in bilateral kidney stones. This fact is sometimes a source of serious complications, and should be taken into consideration in a discussion of the case with the patient. It not infrequently happens that the necessary preoperative study of a case, involving as it does the passage of ureteral catheters, may give rise to infection in one or both kidneys which did not already exist, or, on the other hand, may bring about a sharp exacerbation of an infection already present. We have seen this occur not infrequently, and although the consequences have never been fatal, the patient has often been made ill by the procedure

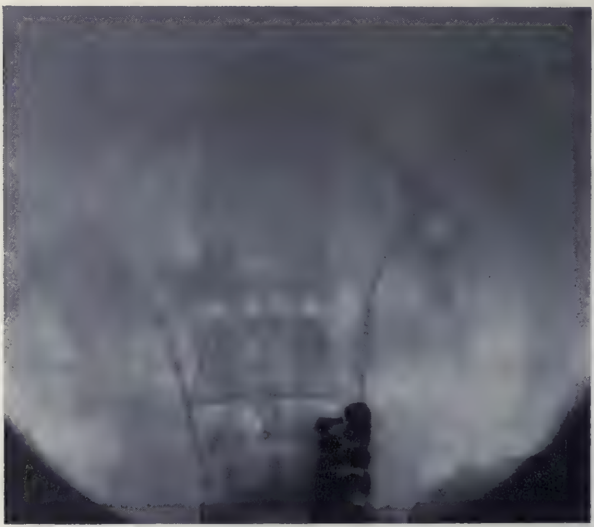

Fig. 344.—*x*-Rays repeatedly negative for two years. Pus and blood from right kidney accompanied by frequent attacks of pain. Pyelogram not abnormal. A flat stone resembling a large piece of clam shell was removed by pyelotomy. The stone proved to be composed entirely of uric acid. After removal it cast a strong shadow under all conditions.

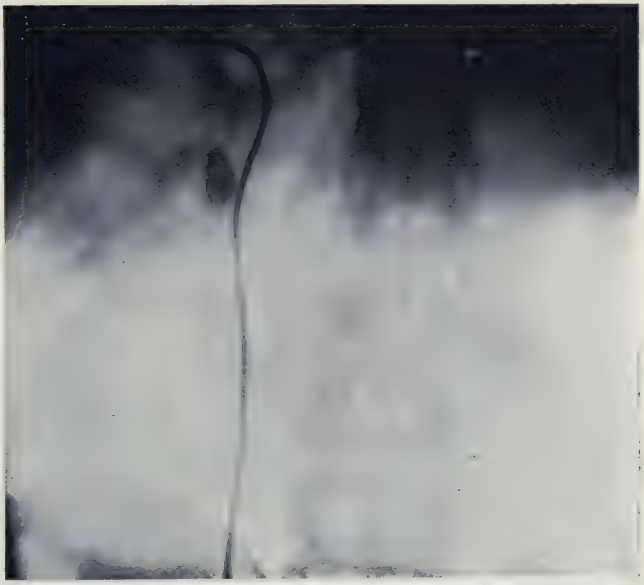

Fig. 345.—Shadow suggests one large stone. No others found at the time of pyelotomy. (See Fig. 346.)

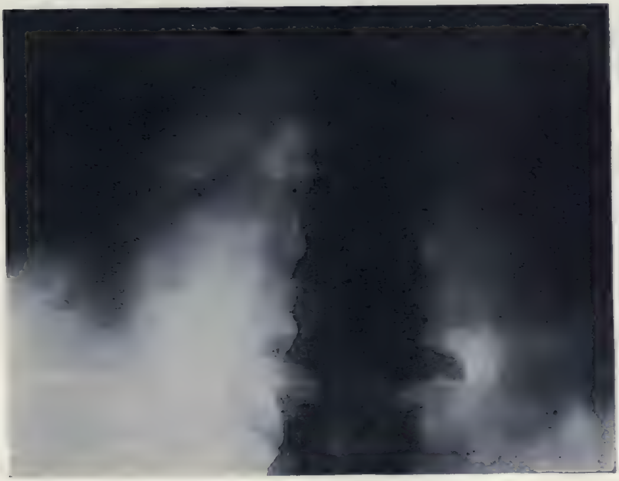

Fig. 346.—Plate taken during convalescence showing several small stones remaining after removal of one large stone by pyelotomy.

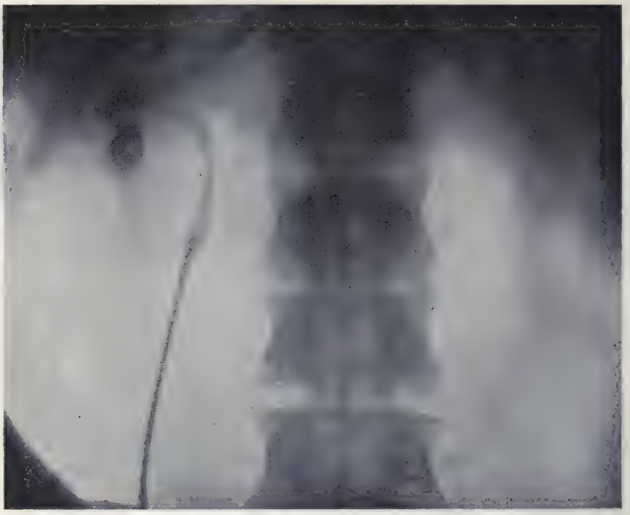

Fig. 347.—Pyelogram shows abnormal pelvis; plates of uninjected kidney show what is apparently one large stone. (See Fig. 348.)

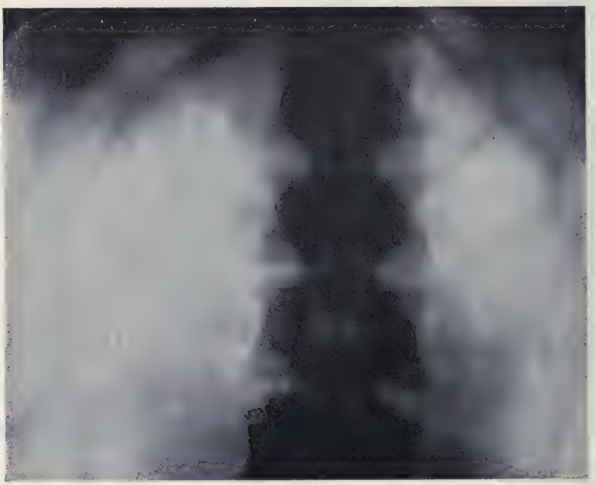

Fig. 348.—Plate taken during convalescence, showing shadow of several stones remaining after removal of one large stone by pyelotomy.

for a considerable period of time. It is particularly unfortunate and serious in the bilateral cases without previous infection

We do not believe that this complication can be avoided, nor do we believe that one should desist from carrying out what is recognized as an essential preoperative study. Nevertheless, the possibility of such a catastrophe should be borne in mind.

During the patient's stay in the hospital previous to operation and while he was being studied the only stone or one of many was spontaneously passed in twenty-four instances. In view of this experience and where only a single small calculus can be demonstrated, it seems not unwise to wait a reasonable length of time for its spontaneous passage, this phenomenon being precipitated without question in many instances by the recumbent posture, free catharsis, large fluid intake, and catheterization of the ureter which proper preliminary study involves.

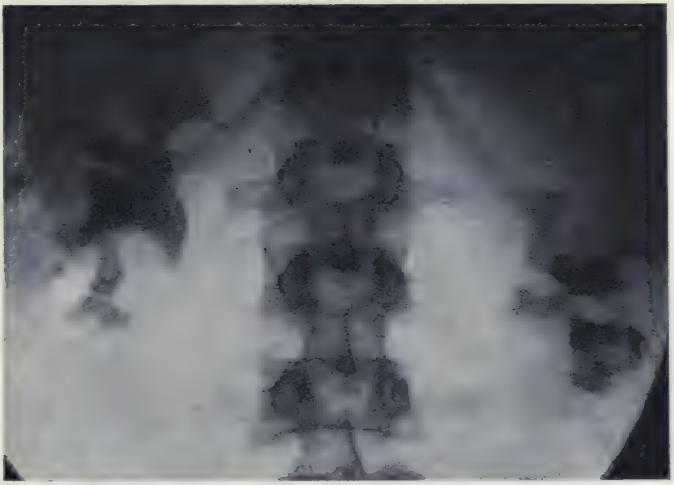

Fig. 349.—Unusually large branching bilateral calculi, resembling a bilateral pyelogram. Patient in excellent condition, urine contained but little pus, pain an insignificant symptom. Renal function of 50 per cent.

If such a calculus does not pass spontaneously and if the patient, lulled into a sense of false security by the subsidence of hitherto frequent attacks of pain, refuses operation, he should at least be kept under constant observation. Only recently one of us (J. D. B.) has had to remove a completely destroyed and badly infected kidney in which a small stone was located by another surgeon about a year previously. At that time the kidney was not in bad condition. Meantime, and without the patient's knowledge, the stone passed down to the ureteral orifice, where it became impacted (Fig. 350), giving rise to the pyonephrosis from which she was suffering at the time of operation. Frequent urinary examination and an occasional *x*-ray would have detected the change in the position of the stone.

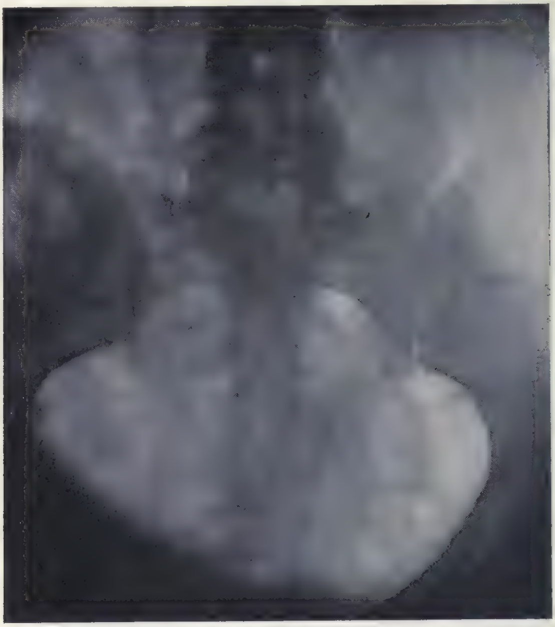

Fig. 350.—Stone impacted in lower end of right ureter, pyonephrosis, nephrectomy. A year previously this stone was detected in the kidney pelvis and passed down the ureter meanwhile.

In this series the calculi were unilateral in 130 and bilateral in 9 cases, or 6.4 per cent.; 18 of our patients were our own re-entries or had had operations elsewhere for renal or ureteral calculus. In 12 of these cases the stones were bilateral at one time or another, involving the kidney alone in 11, and one kidney and the opposite ureter in 1. The difficulties of a second or third operation on the kidney are well known and undoubtedly are a factor in the mortality statistics.

Pyelotomy alone was performed 64 times, and was combined with nephrotomy, generally partial, in 13 others. There were 39 nephrectomies and 17 nephrotomies, of which 3 were bilateral. It is, therefore, apparent that pyelotomy has been the operation of choice, nephrotomy being reserved only for the cases of very large or of multiple calculi. It also follows on this same reasoning that stones of the latter type are far less common than the smaller single stones, an experience which coincides with that of other clinics. We have also found that whereas the shadow found in the roentgenogram often indicated but one stone, one or more additional calculi were found at operation (Figs. 341–343, 345–348). Our experience is, therefore, similar to that of Braasch, who says (Surgery, Gynecology, and Obstetrics, 1917, xxiv), "in many cases where multiple stones were found at operation only a single shadow was found in the *x*-ray."

A chemical examination of the stones removed was made in 47 cases, with the following results: Calcium oxalate 20, calcium phosphate 10, calcium oxalate and calcium phosphate 10, calcium and magnesium phosphate 3, calcium phosphate with urates and calcium carbonate with calcium and magnesium phosphates each 2. It is obvious that calcium forms the basis of most calculi; it is equally obvious that stones composed of urates and uric acid, and more particularly cystin, all of which are apt to give negative *x*-ray results, are not of common occurrence.

There were various postoperative complications, some of considerable moment, others less severe; some were unavoidable, others might be ascribed to faulty technic or judgment. In 2 cases nephrectomy had to be performed shortly after the first operation on account of the persistence or aggravation of previously existing infection; 7 had a urinary fistula of long duration; 3 developed pneumonia; 4 had severe hemorrhage, of which 3 followed nephrotomy and 1 was subsequent to a pyelotomy. There was also one instance of each of the following complications: fecal fistula, ureteral obstruction, hematuria, hemorrhage during operation, shock, and uremia. While there were numerous instances of wound infection, none of these were severe or generalized.

In spite of the fact that these cases were all of the usual hospital class, and that they were operated upon by different members of the staff of 5 surgeons, our general mortality has been 3.5 per cent., comprising 5 cases. There were 2 deaths from pneumonia, of which 1 was uremic and practically moribund at the time of operation, this being done only in a desperate effort to save life. One died of uremia, and here also it was a matter of trying to save the life of a moribund individual. Gas and oxygen anesthesia was responsible for the death of another —a probably unwise choice of anesthetic. Severe hemorrhage after nephrotomy was the cause of death in 1 case.

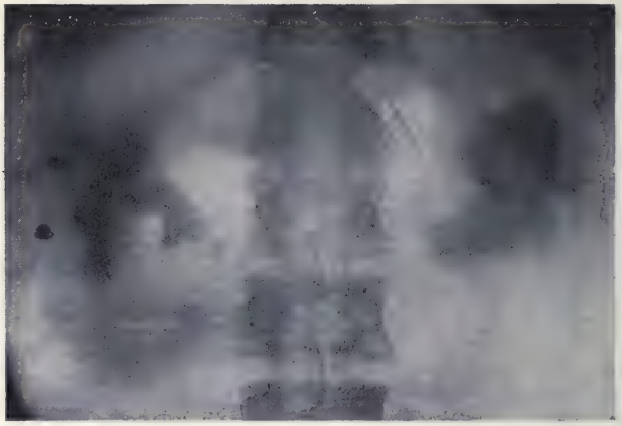

Fig. 351.—Recurrent bilateral, multiple calculi in a horseshoe kidney. Operation, August, 1915, right pyelotomy and nephrotomy; October, 1915, left pyelotomy and nephrotomy.

Operation revealed abnormalities of the kidney in 5 cases, consisting of horseshoe kidney in 3 (of which there were stones in both pelves in one patient, Fig. 351) and an aberrant renal artery over which the ureter was kinked in 2. None of these abnormalities were discovered before operation, and are recorded not only for their intrinsic interest but also to remind the reader that one must always be prepared for some abnormality when doing kidney surgery. The great majority of our cases left the hospital between two and three weeks after operation; a few went home before the fourteenth day with the wound entirely healed, but a still greater number stayed a much longer time owing to one complication or another.

It has already been shown that there are various opportunities for error in the diagnosis of renal calculus, not only as regards its presence but also in respect to the number of stones. To know that there is at least one stone in a kidney is valuable information, but to suspect that a stone is present and be unable to find it at operation puts one in an awkward position. One constantly asks himself whether he has missed the stone in his search through the kidney or whether it was there at all.

The number of patients undergoing operation in whom subsequent examination shows the presence of one or more stones is appalling. While there is no question in our minds that the persistence of the condition in a kidney which produced the first stone may be and often is responsible for the formation of other stones, constituting, therefore, an actual recurrence, we believe that the operation does not remove all of the stones in a great many instances.

Among over 200 cases of renal stone in the hospital records we have found that an x-ray examination of the urinary tract during convalescence had been made in but 20 instances. In 9, or 45 per cent., of these there were shadows in the kidney operated upon, which were undoubtedly those of stone. In 11 cases the roentgenogram was negative. This is a sad record of which we are not proud, but we believe the facts should be made known. Furthermore, we believe that the records of many other clinics both as to the number of postoperative x-rays taken and the number of stones left in the kidney will be found to be equally faulty. In short, we have reason to believe that the matter has not received the attention it deserves and that an effort should be made to improve the situation.

It seems to us that one of the first and most important steps in advance is to insist upon a roentgenogram of the urinary tract during convalescence in *every* case. This measure will not only show whether the operation has been efficient, but it will also furnish reliable data on the question of recurrence. In certain cases with a negative *x*-ray during convalescence the speedy return of symptoms together with a positive roentgenogram raises the question whether one is dealing with a true recurrence or an overlooked stone. But from the patient's viewpoint the net result is the same, and three possibilities are open to him, namely, a second operation, spontaneous passage of the stone, or the *laissez faire* policy, with its doubtful results. What, then, can be done to improve the situation?

In the first place, we believe it to be absolutely essential to establish a preoperative diagnosis which is complete in every particular. It should determine whether or no infection is present and the type of organism; the function of both the affected kidney and its mate should be accurately estimated; properly executed and interpreted roentgenograms should be obtained, as by this means valuable information is furnished not only as to the presence of stone but also as to their size, number, and shape, factors which will help to decide the type of operation to be employed. It may also be said that if one set of plates is negative a second or third set may give positive results.

A pyelogram, with an opaque catheter *in situ*, will, if carefully executed, reveal abnormalities in the size, shape, and position of the renal pelvis and of its calices, and will also give still more accurate information as to the location of the stone.

Second, the operation best suited to the case should be most carefully considered. In some instances regardless of the size or number of stones in the kidney the thick, foul urine, low function, pelvic dilatation or deformity, pyrexia, pain, tenderness, and increased size of the organ will make it obvious that nephrectomy is necessary. There are other cases, however, where with less destruction of the organ one will be tempted to save the kidney. Under these circumstances one will do well to remember the statement of W. J. Mayo (Surgery, Gynecology, and Obstetrics, 1917, xxiv), that "one of the most common causes of recurrence of stone has been attempts to conserve a badly damaged kidney which was of little use functionally and a continuous menace to the patient."

On the other hand, the situation most commonly seen is that of a clean or mildly infected kidney, with a good function and obviously worth saving. These cases again are subdivided into those with a small stone lying in the pelvis or calyx and easily capable of being extracted through a pyelotomy incision, and those with larger or multiple stones, the extraction of which through the renal pelvis is doubtful or at least very difficult.

We believe there is no doubt that pyelotomy is the operation of choice. The dangers of a persistent urinary fistula can be disregarded, and the mortality, as reported by various observers, and in our own experience, has been exceedingly small. Braasch reports 206 cases from the Mayo Clinic without a death. In our clinic, over a period of ten years, there have been but 2 deaths. The success of this operation from the point of view of the presence of subsequent stone, whether recurrent or overlooked at the time of operation, is, however, not so brilliant, but, as we shall show, offers as great a chance of success as the more serious operation of nephrotomy. Cabot and Crabtree (Surgery, Gynecology, and Obstetrics, August, 1915) have shown that in 51 per cent. of cases undergoing pyelotomy at the Massachusetts General Hospital stones were found to be present in the kidney at a subsequent time. While there is no question that some (possibly most) of these stones were actual recurrences, we believe that it is equally certain that many were stones which had been overlooked at the time of operation.

This question cannot be definitely settled, however, as few if any of these cases had had an *x*-ray during convalescence. If, therefore, dependable end-results are to be obtained, all possible sources of error should be eliminated, and in this instance the omission of such an examination immediately gives rise to the possibility of faulty premises. We regret that the literature does not give more information as to the ultimate results of the work of other clinics in the matter of renal calculus. Braasch has reported recurrences in 14.7 per cent. of 88 patients after operation for renal stone, but does not make it clear what particular operation is involved in these figures, nor is it clear that he or some equally competent observer re-examined the cases. The work of Cabot and Crabtree is unique and valuable, in that the figures are based only upon the examinations made personally by the two men. With rare exceptions the results obtained by letter or by the statement of the family physician were not considered satisfactory. One will understand the reason if he recalls that in many instances of renal stone there may be no pain and the urine may be negative.

In the series of 139 cases now under consideration, of which many were among those already examined by Cabot and Crabtree, stones were again found in the kidney after pyelotomy in 32.8 per cent. While we would like to regard these stones as "recurrences," we do not feel that this would exactly fit the case.

Under certain conditions it may be impossible to be sure of removing some stones. Where one is dealing with a small calculus in a calyx with a stenosed orifice it may be impossible to locate this orifice at all, or only after protracted search. Long-continued exploration, no matter how blunt the instrument or how delicate the touch, will generally produce considerable hemorrhage from the pelvic mucosa. The blood may clot around the stone and cover it with so dense a layer of fibrin that it no longer grates on a metal instrument, and even when of considerable size it may readily escape detection. Even when removed the stone may not be felt with the fingers until the heavy coat of fibrin is peeled off. We feel certain that this is an important factor in the so-called recurrent cases. It is also undoubtedly true that where the roentgenogram has shown what seemed to be but one stone, the failure to find and sometimes even to search for others has been responsible for the subsequent results. In view of the "recurrences" reported by Cabot and Crabtree and in the light of our own personal experiences with such cases, we venture to state that there are certain instances in which it is not humanly possible to recover every stone by the operation of pyelotomy unless one calls to his aid some other method of search than the finger and the probe. We believe that the fluoroscope used in conjunction with the operation by a trained observer furnishes us the means of locating many stones which would otherwise be missed. It has been used with success in certain clinics in this country, and we believe that the time will come, if, indeed, it is not already here, when the fluoroscope will be regarded as essential to the proper performance of pyelotomy or nephrotomy. The technic has been so well described by Braasch and Carman (Mayo Clinics, 1919, xi) that it is needless to go into it here, but we feel that a note of warning should be sounded as to its promiscuous use. While the small portable army machine is very satisfactory, there is a very real danger of an explosion of ether vapor from the sparks of the unprotected tube and wiring. Although there seems to be no allusion to this danger in the literature, we have personal knowledge of its occurrence in more than one hospital.

There is now on the market an excellent apparatus well adapted for this purpose and so protected by oil that the danger of sparking is entirely eliminated. With this apparatus one can safely use ether, but in view of the possible danger of the use of this anesthetic with the army machine gas-oxygen anesthesia only should be employed. The ordinary army apparatus can, however, be made safe by housing its tube and wires in a simple wooden cabinet. Some arrangement must be made for turning the tube in any direction and for changing its height, but the work can be done by a good carpenter under the direction of the roentgenologist.

Lest it be thought that the chances of overlooking stones are entirely eliminated by the use of this apparatus in conjunction with the operation, we will briefly recite a recent experience. The patient was a girl of eleven years in whom the *x*-ray showed several small shadows in the left kidney (Fig. 352). The kidney was found to be rather dilated. Two or three small stones were removed through a pyelotomy incision. The fluoroscope was then used, and with its aid one or two more stones were found and extracted. Without this apparatus we feel sure that these particular stones could not have been located or removed except by accident, as they were very small and so covered with fibrin that they produced no grating sensation against a metal instrument and felt and looked like blood-clots. Having removed all the calculi which had been located, another fluoroscopic examination of the organ was made, but no other shadows were to be seen. During convalescence an *x*-ray examination showed two shadows, probably those of calculi, still remaining in the kidney (Fig. 353). While this was an unusually difficult case, owing to the small size and multiplicity of the calculi and to their wide distribution, it shows not only that the fluoroscope was a most invaluable aid but also that even with its use it may be impossible to find all calculi.

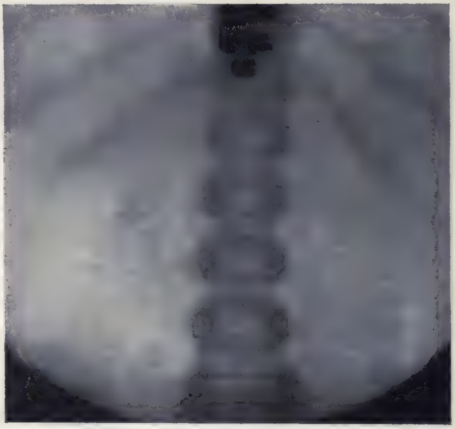

Fig. 352.—Small multiple stones scattered through the kidney pelvis and calices. (See Fig. 353.)

Before taking up certain other phases of the problem of renal calculi we wish to state that our experience has not been happy in the removal of large stones through the renal pelvis by first crushing them within the kidney, a procedure which has been advocated and practised by some. A young woman, epileptic and frail, was admitted to our service with a large renal stone. The kidney was not badly damaged and nephrectomy was not to be considered. One of us (J. D. B.) having only a day or two previously performed a secondary nephrectomy for hemorrhage on a patient of a colleague who had done a nephrotomy for stone a week previously, the idea of a possible repetition of this experience in this young woman did not appeal strongly. The stone was too large to extract through a pyelotomy incision (Fig. 354). It was therefore cracked into fragments with a heavy clamp inserted through the pelvic incision All the fragments were apparently removed and careful search showed no evidence of others. An x-ray taken a week later

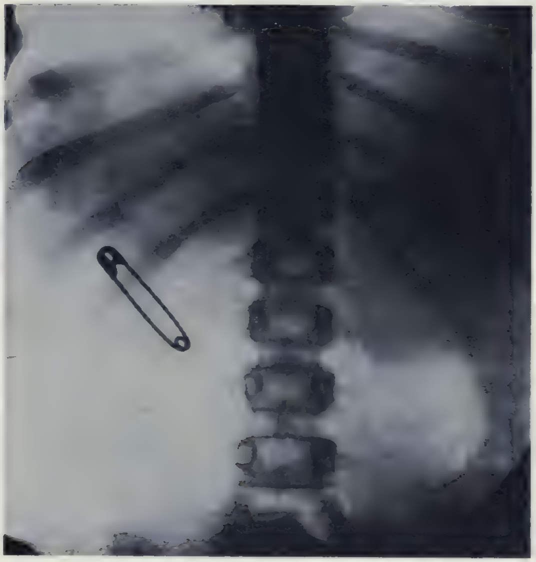

Fig. 353.—Pyelotomy and partial nephrotomy was performed in conjunction with the fluoroscope. Several stones were located by this apparatus which would not otherwise have been found, as they were covered with a heavy coat of fibrin. Careful examination of the kidney finally showed no stones remaining in the kidney. This plate, taken during convalescence, shows one or two shadows which are undoubtedly small stones.

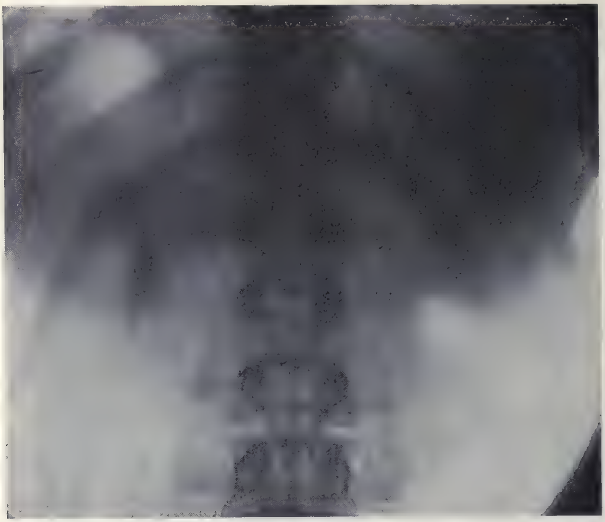

Fig. 354.—Large stone in renal pelvis impossible to remove by pyelotomy. Stone cracked into several fragments with a heavy clamp and extracted piece-meal. Fragments apparently entirely removed.

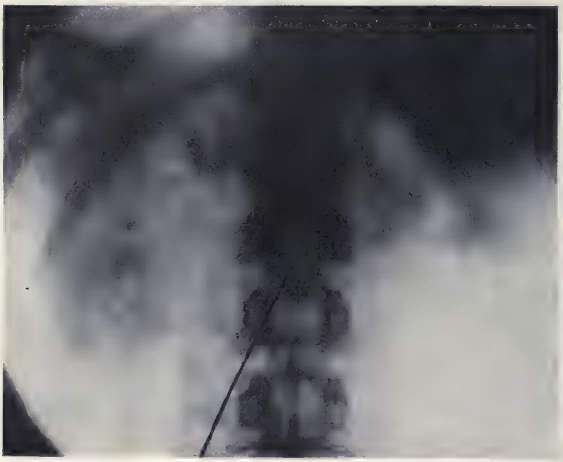

Fig. 355.—Showing fragments still left in kidney (Fig. 354) after crushing a large stone and extracting fragments through pyelotomy incision.

(Fig. 355) showed at least two fragments still remaining. The situation was fully explained to the patient, and a second operation was advised and accepted. At this time two or three fragments corresponding to those shown in the *x*-ray were removed, and every effort was made to have the kidney free of all stones. During the convalescence from the second operation a roentgentogram was taken and, to our surprise and chagrin, a small stone was found to be still remaining in the kidney (Fig. 356). In view of the small size of the stone and the possibility of its subsequent spontaneous passage further interference was considered inadvisable. While we are not proud of this experience, we regard it as a valuable one. It is often impossible to extract even a small stone without breaking it accidentally, and under these conditions the removal of all the fragments is a matter of great uncertainty. To deliberately break up a stone seems to us unwise, even though such a procedure may at first appear to offer a simple solution of the problem.

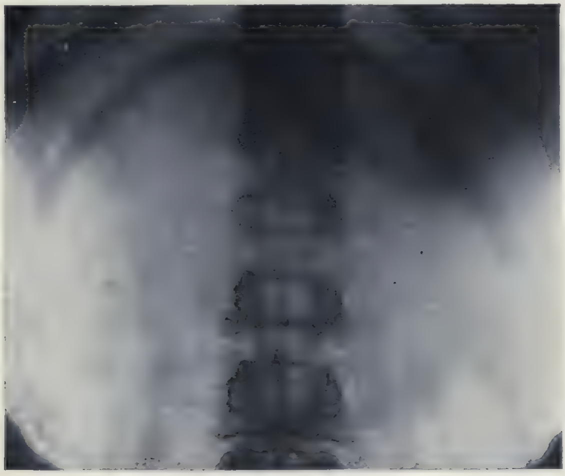

Fig. 356.—Showing one fragment of stone remaining after a second operation (Fig. 355), at which time careful search showed no evidence of stone.

Another point which we wish to dwell upon for a moment is the not infrequent coincidence of renal tuberculosis and stone. Tuberculosis of the kidney is often accompanied by more or less calcification of the organ; actual stone formation is not so common. We have, however, been fortunate enough to see several examples. One of us (J. D. B.) has recently reported such a case (Trans. Amer. Assoc. Gen.-Urin. Surgeons, xiii, 1920) complicated by inguinal renal fistula and transverse myelitis, and has had 2 others in his own practice. Figure 357 shows bilateral renal calculi with tuberculosis of one kidney (catheter *in situ*). In Fig. 358, taken after nephrectomy, a pyelogram was taken of the opposite kidney, and the stone is clearly shown in one of the lower calices. This stone was successfully removed by pyelotomy.

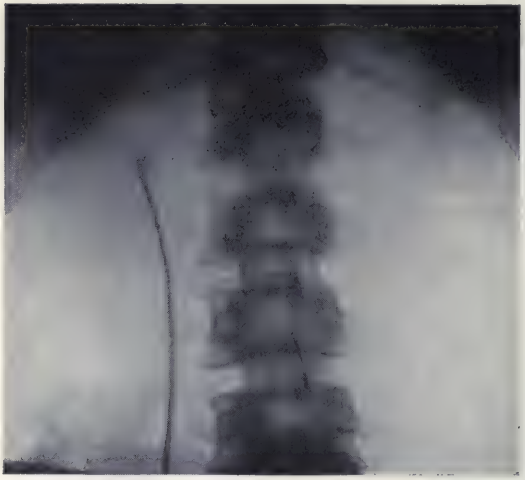

Fig. 357.—Renal tuberculosis with calculus on one side (catheter *in situ*), renal calculus on the other.

Another such case is shown in Fig. 359. The small calculus was situated in the upper calyx of the kidney and produced no renal symptoms whatever. The urine from this kidney contained but little pus, and tubercle bacilli were never demonstrated either by microscopic or guinea-pig test. Owing to the extremely bad condition of the patient's heart it was thought best to end all possibility of further operation on this kidney by removing it. This proved to be a fortunate step, as the pathologist reported tuberculosis, involving chiefly the calyx in which the stone was located.

We feel that this experience is of value, as where the *x*-ray indicates a renal calculus it is apparently possible at times to find a coincidental tuberculosis of the kidney, a condition for which nephrectomy should be performed as a primary, and not a secondary, measure.

If, then, pyelotomy, with or without fluoroscopy, so often fails in its purpose, it might be supposed that nephrotomy, an operation by which the interior of the kidney may be inspected and palpated, would accomplish the desired results. A review of the situation does not, however, show this to be the case. In the article by Cabot and Crabtree already referred to the end-results of 30 cases of nephrotomy were obtained by personal examination of the patient, including *x*-ray and urinalysis; 56 per cent. of these cases showed stone in one or both kidneys at this examination, a somewhat higher percentage than that found after pyelotomy. In the present series the percentage of stones after nephrotomy was 30.3 per cent., a figure which

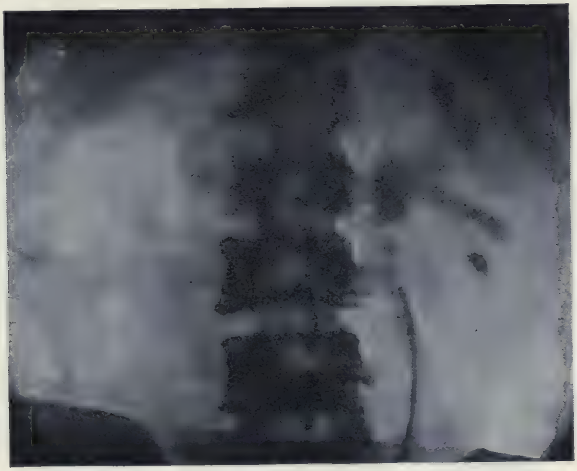

Fig. 358.—Same as Fig. 357 after nephrectomy for tuberculosis. **Pyelogram** showing stone in lower calyx of kidney. Successful removal **by pyelotomy.**

might be higher were we to have gone into the end-results intensively. The cases on which we base this statement, as well as that of the results of pyelotomy, were either re-entries in our service, coming in for a second operation; those admitted for the first time after having had a previous operation elsewhere; those coming to the out-patient clinic as our own re-entries, or as new cases.

The success of nephrotomy, therefore, cannot be said to be brilliant. The probable explanation of the high percentage of recurrence is that the primary condition for which the operation was done was one of large or multiple stones, and the still unknown circumstances producing such stones was not altered by operation. Granting this premise, we are dealing with actual recurrences. On the other hand, the arrangement of the calices may be such that even with a kidney fully opened one or more of these stone-bearing cavities might be easily overlooked, in which case the term "recurrent" stone would not be applicable.

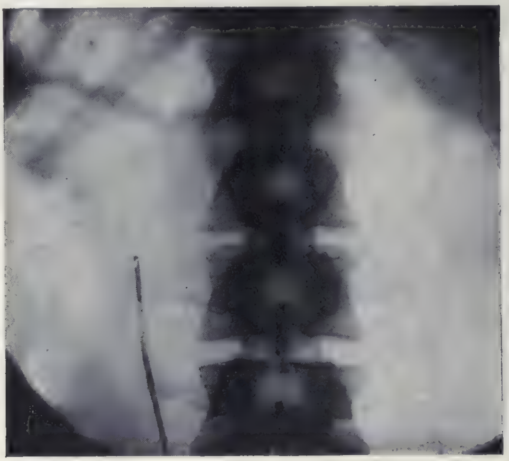

Fig. 359.—Renal tuberculosis with stone in the upper calyx of the left kidney, guinea-pig negative on two occasions; tubercle bacilli never found.

Nephrotomy, therefore, has real drawbacks, the least of which is the possibility of recurrence of the calculus. The operation is of comparatively recent date, as we are told by Watson (Watson and Cunningham, Genito-urinary Diseases, ii) that one of the earliest, if not the earliest, operation of this nature was performed by the late Dr. William Ingals at the Boston City Hospital on October 8, 1872. Newman (Lectures on the Surgical Diseases of the Kidney, 1888) refers to an operation for the removal of stone done by Durham in 1872. Sir Henry Morris (Surgical Diseases of the Kidney and Ureter) performed this operation in 1880, and claimed that it was the first of its kind ever performed. Be that as it may, nephrotomy proved from the first to be a dangerous and difficult procedure.

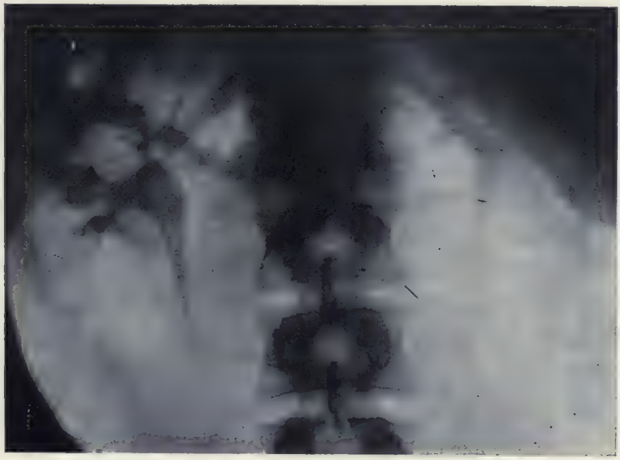

Fig. 360.—Pyelogram of kidney shown in Fig. 359. Upper calyx has a ragged appearance and its extremely long and narrow outlet is of interest.

Watson (*loc. cit.*) collected from the literature 309 cases, with 29 deaths, a mortality of 9.3 per cent. Where the kidneys were "infected" the mortality among 87 cases was 18.3 per cent., while where they were "uninfected" there was a death-rate of 2.2 per cent. among 135 cases. It must be remembered, however, that these cases were culled from the literature of an earlier day when the question of renal infection was less understood than at present.

A recent report of Braasch (Surgery, Gynecology, and

Obstetrics, 1917, xxiv) of the operations for renal stone at the Mayo Clinic shows no mortality among 40 nephrotomies. We regard this statement as significant. It shows in the first place how comparatively infrequent an operation nephrotomy is in the work of skilled operators, for in 484 operations for renal calculus there were 206 pyelotomies, 188 nephrectomies, 16 nephro-ureterectomies, 40 nephrotomies, and 34 operations in which pyelotomy was combined with nephrotomy. It is obvious that in most cases where pyelotomy will not suffice either for the removal of the stone or for proper drainage of the kidney, the removal of this organ is deemed the wiser procedure. While there has been no mortality from nephrotomy the convalescence has apparently not always gone smoothly, as W. J. Mayo (Surgery, Gynecology, and Obstetrics, 1917, xxiv) states that "several had hemorrhages after operation, and in 4 it was necessary to do a nephrectomy to save their lives." Bevan (Surgical Clinics, Chicago, ii, 1918) has had a similar experience, and has had to do a secondary nephrectomy in 8 or 10 cases within one or two weeks after nephrotomy.

After reading these reports we feel that a statement of our experience with nephrotomy at the Massachusetts General Hospital will be of interest. There have been 70 cases from 1897 to date. The operative mortality has been 5.7 per cent., comprising 4 cases, of which 2 died as a result of secondary nephrectomy for hemorrhage, and 1 died of streptococcus septicemia. In the fourth case the record failed to state the cause of death. There were 11 secondary hemorrhages (15.7 per cent.), of which 3 required nephrectomy. In 7 the bleeding ceased spontaneously and the patient recovered; in 1 case the wound was successfully packed. The ages of the patients ranged from eleven to sixty-four years.

In 28, or 40 per cent., multiple stones were found, in 33, or 47.1 per cent., a single calculus was removed. In 10 no stone was found, but these cases occurred mostly in the early days when the *x*-ray and cystoscope were less frequently employed. In 3 cases there was a simultaneous bilateral nephrotomy, in another the second kidney was nephrotomized after an interval of a few days. The "recurrence" in this set of 70 nephrotomies runs as high as 52.9 per cent., a figure which compares closely with that of Cabot and Crabtree, and which should leave no doubt in anyone's mind that the operation is not always productive of success. Furthermore, when one considers how frequent is the occurrence of secondary hemorrhage, and how often nephrectomy must be done to save life, he should consider well all the other possibilities before undertaking this operation. This is especially the case in view of the high percentage of recurrence shown to occur after the patient has been fortunate enough to escape the dangers already enumerated.

In 11 of our cases (15.7 per cent.) convalescence was interrupted by postoperative hemorrhage. In 3 this bleeding was so severe that nephrectomy had to be done, on the eighth, nineteenth, and twenty-first days respectively, indicating that hemorrhage which is severe at its onset, or which becomes so by its continuation, does not always tread on the heels of the operation. One patient bled quite steadily for eighteen days, at which time the kidney was packed with gauze and recovery took place. The remaining 7 had more or less bleeding either through the wound or through the urethra, but in all it ceased spontaneously under careful and well-judged observation. It may be remarked here that the question of whether or not to interfere in the presence of hemorrhage calls for the best surgical skill. In cases of massive hemorrhage with all the well-known symptoms there can be no doubt of the necessity. In other instances where the bleeding is less severe the situation demands the most expert judgment. One hesitates to pack a kidney or to take it out unless it is absolutely necessary; on the other hand, he who waits till the last moment finds himself operating in frantic haste on a patient who is not only exsanguinated, but who has also hardly recovered from the effects of a long and bloody operation only a few days before. The results of such delays are often fatal.

In 21 of our nephrotomies (30 per cent.) the kidney was simply packed with gauze at the time of operation. In 4 there was postoperative hemorrhage requiring nephrectomy in one instance, additional packing in another. In 36 cases (52 per cent.) the kidney was closed by suture, generally with a flat piece of gutta-percha drain down to the pelvis. Six of these cases developed a postoperative hemorrhage requiring nephrectomy on the nineteenth day after operation in one instance. In the remaining cases (18 per cent.) the kidney was sutured around a rubber tube placed in the pelvic cavity, and postoperative hemorrhage occurred in but one of these. It appears, therefore, that the manner of handling the kidney after nephrotomy has little or no influence upon the incidence of subsequent hemorrhage, although those in which a rubber tube was used seemed to have fared better. The general opinion among surgeons seems to be that the kidney should be sutured rather than packed, but one must always bear in mind the possibility of destroying additional renal tissue by tying the sutures too tightly, or by so placing them that they will cut off the blood-supply from large areas.

In the more recent cases we have resorted to the method of splitting the kidney from within outward by means of silver wire threaded either on a curved liver needle or, better, on a blunt, flexible probe. The cases in which this method has been used in preference to the old method of dividing the kidney from without inward by means of a knife are too few to enable us to express any final opinion as to its possible advantages. Experimentally it seems to have reduced the likelihood of hemorrhage both during operation and subsequently.

A survey of the possibilities offered by nephrotomy are not brilliant. The higher mortality, the likelihood of postoperative hemorrhage with its serious accompaniments, and the undoubtedly great number of stones found later either as left-overs or as actual recurrences, should make one hesitate to select nephrotomy as the operation of choice.

Lest the surgeon, having in mind the somewhat disheartening data presented, might hesitate to advise or perform operation for the removal of renal calculi, we wish to state emphatically that such a course will almost inevitably be a source of regret to the patient if not to the surgeon. In spite of the high percentage of "recurrences" here reported the patient should not be encouraged to carry about with him until necessity forces the issue a stone which is surely but insidiously doing serious damage to his kidney. In most instances a pyelotomy will suffice to remove the stone, and we have pointed out the small risk attending this procedure. Even though nephrotomy is deemed necessary, the mortality is not terrifying, nor should the chance of secondary hemorrhage act as a deterrent. In other words, it is safer in the long run to remove a stone than to allow it to remain in the kidney.

In closing we wish to make a plea for the more intensive study not only of the diagnosis of renal stone but also of the operative technic. The matter of end-results is a question of universal interest and one which has not received its due share of attention. The acquisition of reliable data is possible only if satisfactory roentgenograms are taken after as well as before operation. In view of the importance or, rather, the necessity of personal examination of the patient and of good radiographs, the collection of reliable and large statistics of end-results is difficult, but not impossible. We believe that such data will be more encouraging than those already collected if some of the pitfalls already enumerated are borne in mind and if the fluoroscope is used in conjunction with the operation.

CLINIC OF DR. JOSHUA C. HUBBARD

BOSTON CITY HOSPITAL

RECTOVAGINAL FISTULA

THE method which I shall describe of dealing with a rectovaginal fistula is so simple in technic and so satisfactory in result that I am sure it must be in use by many surgeons, even though no mention of it can be found in recent books on surgery or gynecology. Where reference is made to an operation perhaps somewhat similar not enough details are given to make the various steps clear, and often some of the essentials are omitted.

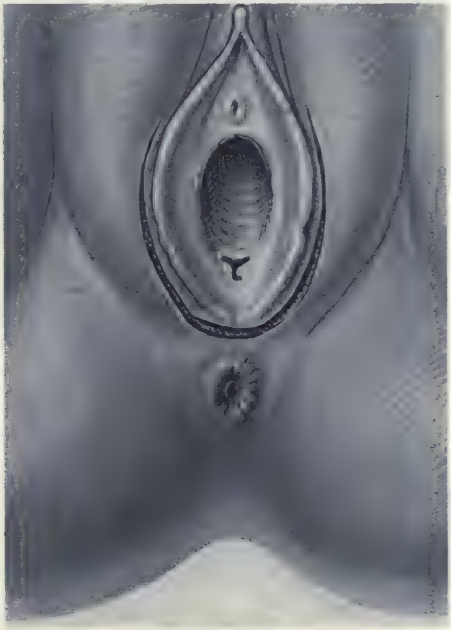

Fig. 361.—The skin incision.

If the operation is an old one which has been forgotten, it is time now to call attention afresh to its good features.

The condition causing a rectovaginal fistula almost necessarily leaves a woman with a badly torn perineum. This operation is planned not only to cure the fistula, but to repair the perineum.

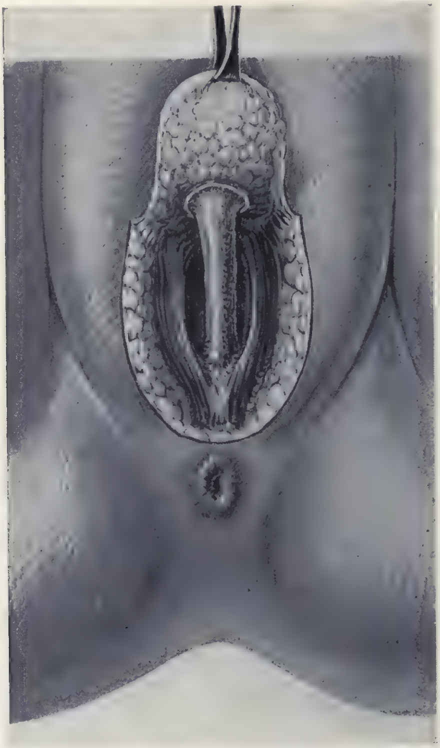

Fig. 362.—The dissection of the fistulous tract.

The various steps of the operation are made clear in the accompanying drawings.

A curving incision is made at the line of junction of the mucous membrane of the vagina and the skin. It begins high on one side and swings down and up to a corresponding point on the opposite side (Fig. 361). A flap of mucous membrane is turned up from the floor of the vagina till the fistulous tract made evident by a probe passed through it is reached. This is dissected out intact (Fig. 362). An incision about the vaginal opening is made. A hemostatic forceps is passed through the fistula from the rectum, fastened to the vaginal end, then pulled back through the rectum, turning the fistula inside out (Fig. 363). Should the fistulous tract be too small to admit even a mosquito hemostatic forceps it might be possible to accomplish the inversion by a suture fastened at the vaginal end of the tract carried down through the fistula and out the rectum. A pull on this would invert the tract unless its lumen were too small to accommodate the thickness of its wall. By putting some tension on the fistulous tract thus turned inside out the sides of the fistula, where it passes through the rectal wall, are brought to-

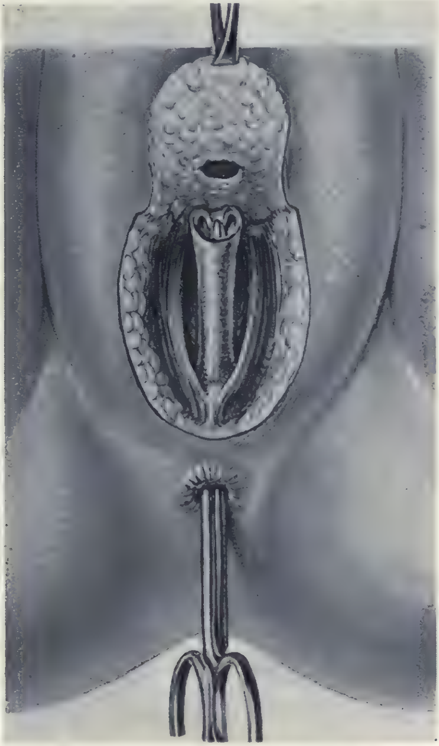

Fig. 363.—The beginning of the inversion of the fistulous tract.

gether. The opening in the rectum is then closed on the perineal side by catgut sutures which may be placed so that the knot is in the rectum or not, as one pleases (Fig. 364). The excess of tissue containing the fistula is cut away, the opening in the vaginal mucous membrane is closed. The perineum is then repaired by pulling the muscles on either side of the denuded area together by buried catgut sutures (Fig. 365).

This operation is naturally most easily done when the fistula is situated low down, but is applicable to one higher up, the limit being only determined by the accessibility. It has the distinct advantage of entire removal of the fistulous tract and separation of the suture line in the rectum from that in the vagina, by considerable distance, by the aid of the plastic, which places the thick bellies of the perineal muscles between the two suture lines, thus materially decreasing the chance of recurrence.

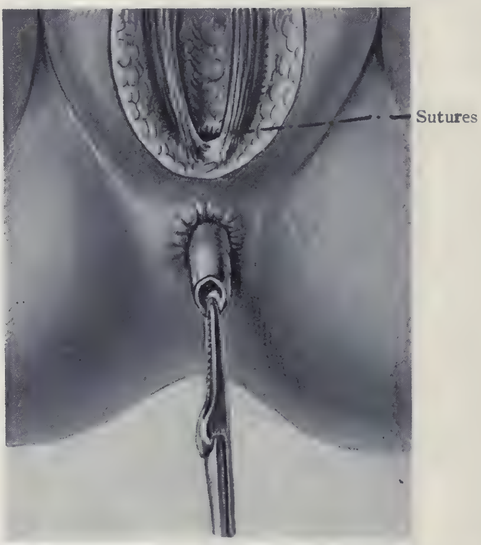

Fig. 364.—Fistulous tract completely inverted. The opening of the rectal wall sutured.

This short paper is intended to serve as a reminder of an old, perhaps forgotten, technic which may help to cure some of these at times difficult cases.

David (Surgical Clinics of Chicago) mentions an operation apparently very similar. The technic of the different steps is not clearly given, and no mention of any plastic on the perineum is made—a serious omission.

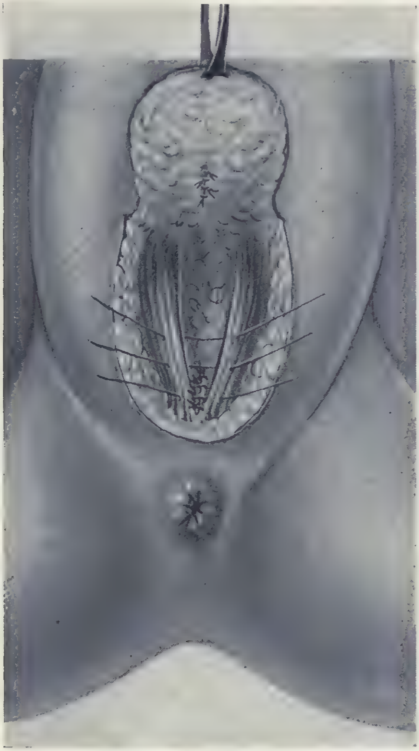

Fig. 365.—Opening in rectal wall and vaginal wall closed. Sutures placed in the muscles of the perineum.

After this paper had been promised and finished for the Surgical Clinics of North America, an article on Perineorrhaphy for Complete Lacteration by Watkins appeared in Surgery, Gynecology, and Obstetrics for April, 1921, describing and illustrating a technic very similar to the one described above.

CLINIC OF DR. FREDERIC J. COTTON

CHIEF CONSULTANT IN SURGERY, U. S. PUBLIC HEALTH SERVICE,
PARKER HILL HOSPITAL, BOSTON

A "RECONSTRUCTION" CLINIC

THE cases here reported are those shown to the Boston Surgical Society March 7, 1921, at the Parker Hill Hospital of the United States Public Health Service, successor to United States Army General Hospital No. 10, by my colleagues and myself.

In the main they represent work of the type we have come to call "reconstruction" work.

They represent a list of 50 of the interesting cases of the year past, sent out for, to report on the given date, sent for "sight unseen," cases shown as they came—good and poor results together, as chanced.

It is time that more attention be paid to reconstructive surgery, involving as it does (1) more than the usual care as to the picking of cases, with ruthless rejection of some and postponement of those cases in which early operation means undue risk; (2) refinement of procedure, of local preparation, and of operative technic, so as to avoid the disasters that have marred the record of such work in the past (and even during the war years); (3) careful fitting of the operative plan to the *functional* result that one desires to reach; (4) meticulous care in convalescence; (5) after-care under the best of physiotherapy, carefully checked up by the best *surgical* supervision.

It is not pretended that the cases here presented measure up to this standard, but it is true that they were cared for under conditions of proper equipment and picked and experienced personnel and *continuous* personal supervision throughout, conditions much more favorable than in most public hospitals.

The results are no better surely than we ought to get anywhere, given these favorable conditions.

The material certainly is not favorable, consisting of men in early adult life, to be sure, in most cases, but, on the other hand, representing not the successes, but the "culls" and failures of a long succession of army hospitals.

Case I.—Operation before the clinic, ——, ——, age twenty-two years.

History of years of trouble with the left knee, with occasional locking and subsequent synovitis of a few days. Never any locking of considerable duration. Tenderness (and point of apparent obstruction) to the outer side. On examination showed nothing objective save slightest blurring of bone outlines and a little laxness of capsule and a little atrophy of quadriceps muscle. Slight abnormal mobility of tibia on femur forward. x-Ray showed a small bone nodule in middle of joint. Operated on because of the intermittent crippling from displacement of the external cartilage, not for the laxity of the joint.

Operation, 3/7/1921. Cotton operating. Cotting and Dunphy assistants. Ether anesthesia.

Long sweeping incision carried 1½ inches to inside of middle of patella. Skin and superficial fascia dissected back. Knee flexed, knife cut to patella, midline. Saw cut in vertical line about ½ inch in. Patella then split with chisel placed in the long axis of the patella (not cutting toward the femur) and opened up. Cut from ends of this fracture line through the tendon up to the top of the quadriceps pouch and down to the tibial tubercle, including the midline fat pad and the ligamentum mucosum. Joint then opened up and flexed. The bone node proved to be in the anterior crucial ligament, from which it was shelled out. One catgut stitch in the slightly lax ligament. This node entirely *within* the ligament—apparently grew there. External semilunar cartilage loose and showing the thinned-out scars of many pinchings. The back half was displaced forward and lay in front of the femoral condyle, folded almost in contact with the front half. Whole cartilage removed.

The outer ligamentum alarium showed hypertrophy and distinct scarring and thickening from being pinched. This, the corresponding inner fringe, and much of the fat pad below the ligamentum patellæ removed, and the gap in the synovia brought together with catgut sutures in the fat, not penetrating the joint. Joint washed out with salt solution. Knee then straightened and the joint closed—not too tight—with a few gut sutures in the tendon, not going through to the joint surface, and close suturing with kangaroo tendon of the periosteal fascial layer across the gap in the patella. Loose skin sutures of silkworm-gut. Dressing, ham splint; no plaster.

(Later, motion begun at two weeks. Splint off at three weeks. This case happened to show almost no effusion or other reaction.)

Old Cases: Knees.—*Case II.*—W. W. D. Age thirty-six. Machinist. Diagnosis: Loose bodies, left knee-joint.

On February 2, 1920 patient twisted his left knee while at work in navy yard. Injury did not seem severe, but began to trouble him in a few weeks, and since then has intermittently laid him off from work.

Admitted to this hospital March 5, 1920. Examination revealed movable body felt in left knee at inner aspect of patella. Painful to pressure, motion not limited. Decision made to do radical operation because of osteochondritic changes obvious in the *x*-ray, as well as because of the loose body.

March 10, 1920: Ether and "Corner" operation. F. J. Cotton. Median arthrotomy. Removal of three loose bodies with excision of redundant fat pad; osteochondritis desiccans changes, mild grade. Knee put in plaster. Cast removed March 24th, active motion started. Uneventful recovery.

Examination 3/7/21.

Complaint: None.

Excellent result. At work at former occupation at Charlestown Navy Yard. Full range of motion.

Case III.—J. C. Age twenty-six. Salesman. Diagnosis: Dislocation, internal semilunar cartilage, left knee.

In October, 1918 patient fell on left knee while running.

Limb was injured to such an extent that he had to be assisted to his bed. He reported to sick call the next day and was laid up for six weeks. Patient has never been able to do a full day's work since the accident, and gives history of locking at various intervals. Patient was admitted August 17, 1920.

Examination reveals slight swelling of left knee, with considerable thickening of knee-joint. Knee can be flexed completely, but extension is limited about 10 degrees. Has definite point of tenderness over internal cartilage.

August 28, 1920: Ether and operation. F. J. Cotton. Usual *lateral* incision was made over left knee-joint. Joint opened and internal cartilage, anterior end, found torn loose and dislocated backward. This cartilage was removed in the usual manner. No arthritic changes noted. Knee-joint closed and posterior splint applied.

Wound healed and gentle motions started in ten days. Patient allowed up on crutches in thirteen days. Manipulations daily. Physiotherapy started.

Examination 3/7/21.

Complaint: None.

Full range of motion; no limp; good result.

Case IV.—G. A. Age thirty-two. Married. Admitted May 21, 1920.

Began to have trouble with knee in army about September, 1918, without any single trauma. Since then has been able to work for a while, but at intervals knee swells and becomes sore and useless. Shows nothing on examination except swollen knee with capsular thickening of the villous arthritis type.

Operation May 22, 1920: Cotton. Longitudinal "Corner" incision. Marked villus proliferation. Cartilages loose, both cartilages; and a large amount of villous growth removed, including the ligamenta alaria on both sides. Splint worn until June 6th. After this time active use with massage. Discharged first of July. Re-examined March 7, 1921. Shows knee substantially normal, though bony outline not as sharp as on the other side. Says he has occasional discomfort in it, but nothing to interfere with the use of it to any extent.

Case V.—J. G.—Referred by Dr. C. F. Painter, of the Naval Hospital, for semilunar cartilage. Typical history of recurring luxation of internal semilunar, with fleeting synovitis following each "jamming."

Operation, 1920: Typical oblique incision on the inner side, with removal of the internal meniscus torn across not far from the front end. Front end of cartilage removed and the back end as far as scissors would reach. Nothing else found.

March 7, 1921: Practically perfect result. Full motion. No disability, though joint not quite as strong as normal.

Case VI.—N. R. Age twenty-nine. First seen by me in spring of 1919, with occasionally recurring synovitis of left knee originally following slight trauma. Each attack with pain, local heat, some fluid. Physiotherapy, etc., tried out. Tonsils removed in December, 1919. He wearied of all this and finally prevailed on me to operate.

February, 1920 operation: Long "Corner" incision, and, to my surprise, very definite scars from pinching of the internal ligamentum alarium. Both ligamenta alaria and the internal meniscus removed.

Usual routine, with motion after two weeks.

Recovery a bit slow even under baths and massage and exercises, but March 7, 1921 shows a knee slightly thickened as to capsule, with occasional sensitiveness and heat, but substantially normal.

Case VII.—L. A. C. Age twenty-four. Inspector of Ordnance. Diagnosis: Old fracture of medial condyle of left femur.

Patient fell on timbers at Fort Strong July 1, 1918. Was in hospital about three months, and has not been able to do full duty since.

Admitted to this hospital January 15, 1920. Examination of left knee shows limitation of extension of about 30 degrees, sharp bony limitation, and some backward luxation of leg. Crepitus is felt and heard over the internal side of the joint. *x*-Ray shows old fracture of condyles, with the back part displaced back and up, with the tibia, leaving a shelf in front, against which the tibia "chocks up" in attempted extension (Fig. 366).

January 30, 1920: Ether and operation. F. J. Cotton. Knee-joint opened. "Corner" technic, rather extensive bone plastic in remodeling of deformed condyles performed. Cast applied. Considerable reactive synovitis (Fig. 367).

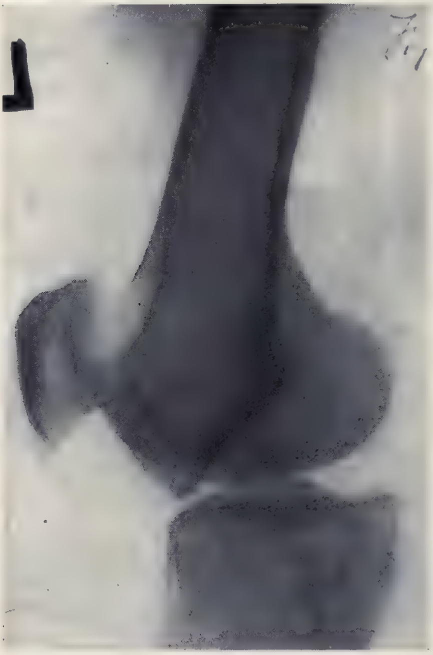

Fig. 366.—Case VII. *x*-Ray showing old fracture and absolute check on extension due to bony deformity within the joint.

February 24, 1920: Cast removed and physiotherapy started.

Examined March 7, 1921.

Complaint: Discomfort in cold weather. Walks with slightest limp. Has practically full extension. Muscle development and power about normal.

Case VIII.—D. F. S. Age twenty-one. Occupation, longshoreman.

Diagnosis: Ruptured crucial and internal lateral ligaments, left knee.

While playing football at Camp Devens, Massachusetts, in 1918 patient was thrown to the ground and left knee severely wrenched. Admitted to this hospital June 19, 1920, complaining of weakness after walking short distances. Knee is unstable and patient cannot bear his weight for any length of time. Complains of some slipping and of noise. There is a rather appalling crunching noise on flexing the knee under weight—not on loose flexion. There is considerable anteroposterior mobility, moderate laxness laterally. No swelling. Synovitis occasional only. Recommended by me to hospital after some months of watching and various ineffective palliative treatments.

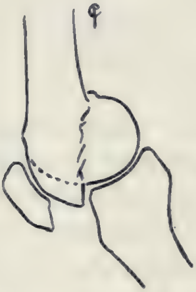

Fig. 367.—Case VII. Diagram of operation.

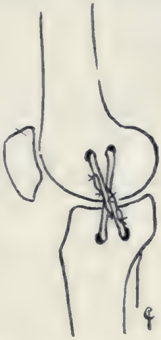

Fig. 368.—Case VIII. Diagram of operation: Artificial internal lateral from fascia lata, rove in under the cortical layer above and below; all outside the joint.

June 29, 1920: Ether and operation. F. J. Cotton. Incision was made over the internal condyle of left femur extending down over internal tuberosity of tibia. Knee-joint opened and crucial ligaments found to be torn. Semilunar cartilages found to be hypermobile, internal one being removed and crucial ligaments trimmed. Incision made over outer surface of thigh and 8-inch strip of fascia lata removed about $\frac{3}{4}$ inch wide. From the posterior lateral surface of the internal condyle this fascia lata strip was inserted through drill holes and lashed, stitched, and fixed. This was stretched down anteriorly where it was attached in similar manner to the anterior lateral surface of the tibial tuberosity, forming an artificial internal lateral ligament stretched over the healed but lax original ligament (Fig. 368).

Patient was allowed up on crutches in August, and allowed gentle active motion assisted by physiotherapy. From this date on, motion gradually increased.

Examined 3/7/21.

Complaint: Tires on long exertion. Walks without limp. Very stable joint. Noise has disappeared. Reports having had a bit of slipping three or four times, only slight. Ligament palpable. Lateral motion none, anteroposterior motion very little.

Case IX.—W. M. S. Age forty-four. Occupation teamster. Diagnosis: Crush of left knee, resulting in permanent flexion.

On June 26, 1917, while driving team, patient was thrown to the ground, sustaining laceration of left knee. Was treated at Waltham City Hospital until November 26, 1917, during which time sepsis developed, involving the tissues about the knee-joint. Patient received treatment at the Orthopedic Out-patient Department, M. G. H. On examination shows very extensive and deep scars of outer side and popliteal space, with permanent knee flexion of 30 degrees; joint free, but not over 10 degrees. Joint lame. Tires easily. Unable to work.

In July, 1918 the tendo achillis was cut to relieve dorsiflexion deformity.

Admitted to this hospital January 12, 1920.

January 16, 1920 (under ether): Tenotomy of the hamstrings and stretching was performed. Leg put up in plaster, which was worn until February, 1920. Cast was removed, and walking caliper splint with anterior knee pad applied.

March 9, 1920: Only small amount of motion possible. Knee extends to an angle of 145 degrees. Physiotherapy treatment for about two months, with very little improvement. Patient unable to bear weight without the aid of the splint.

June 22, 1920: Ether and operation; Dr. Cotton.

A supracondylar osteotomy was performed on the anterior surface of the femur, and leg put up in extended position in plaster.

Recovery was uneventful, and in eight weeks firm union was obtained.

Examined 3/7/21.

Complaint: Limp. Weakness. Toe-drop. Has about 15+ degrees motion. Partial toe-drop. Toe-drop splint ordered.

There is a good deal of tenderness still, though the leg is solid and straight. The toe-drop discovered 3/7/21 developed since his discharge.

Résumé of Knee Cases.—Noteworthy that, as I have long contended, the long incision advocated by Corner heals without more reaction than the peep-hole incisions, and as quickly and well, and enables us to get a decent view.

For simple demonstrated cartilage cases—like Cases III and V—the little old-fashioned incision is enough, and I still use it.

For any case not quite clear, like Cases II or IV or VI, or cases for extensive dissection, like Case VII, there is nothing to my mind to excuse less than the radical opening-up.

It is rather astonishing how often one finds something in addition to the diagnosed lesion.

Case VII must be nearly unique, the result a very satisfactory reward of radical handling.

Case VIII is my way of handling the loose traumatic joints. The first case, about seven years ago, was moored with braided silk on both inner and outer side. The silk came out, as we later learned was the habit of silk so used, but the joint stayed stable. Since then I have always used fascia lata rope, run through drill holes in under the cortical layer, running a bit obliquely from just in front of the axis of rocking on the femur down and slightly back (this in case the femur goes forward, reverse if it tends to slip back). The new ligaments may be pulled very tight and laced and lashed with sutures. This operation does not open the joint, though I deliberately opened it to explore in Case VIII.

In the half-dozen cases in which I have done this operation results have been very satisfactory, with no lax joints after operation, and I regard this as the operation of choice in the type called ruptured crucials, in which the joint has loose motion laterally as well as anteroposteriorly.

A little study shows which lateral, internal or external, is lax.

Save in rare cases in which one can suture back a torn-off spine I can see no prospect of any stability in direct repair of crucials, or in any operation save the crossing in the notch of sutures or wires penetrating condyles and tibia in an **X** pattern, an operation discredited if silk or wire are used, untried, I think, with fascia.

But if the technic here detailed does the work, why rip things up so much for a doubtful advantage, to say nothing of the chance of trouble.

I present this technic as *the* way to deal with these lax joints.

Case IX is a failure.

Osteotomy was deliberately chosen instead of arthroplasty because of the chance of infection on the face of the very extensive and deep scarring all about the knee. It would evidently have been better to do an excision in slight flexion, the present disability being largely due to the remaining mobility, small and worse than useless, as it proves, but even today I should hate to chance an excision with so little intact skin to cover up with.

Old Cases: Recurrent Shoulder Luxation.—These cases were all handled by the technic detailed by the late Herbert L. Burrell in an article published in Trans. Amer. Surg. Assoc., 1897, p. 293. I have not done many of these, but have followed his technic not only as written, but as I had the good fortune to see him carry it out. The gist of the matter is a *sufficient* reefing of the capsule at the point where the subscapularis muscle merges with the capsule (the subcapularis "tendon") and below this point. Every case I have seen shows a marked slack of the front and lower capsule—enough to take a reef of ½ to ¾ inch.

One must cut to get raw surfaces, though there is no need of opening the inner synovial capsule (it was not opened in any of the following cases), and then one may overlap or quilt up the raw, cut tissue in a central ridge; that is immaterial, so that one takes up the slack and takes it so that it will stay.

The incision is "Hueter's" long anterior incision.

Case X.—R. M. Age twenty-seven. Machinist.

Diagnosis: Recurrent dislocation, left shoulder.

While at bayonet practice September, 1917 patient dislocated his left shoulder. Was discharged on account of this disability in December, 1917. While at home dislocated the same shoulder four or five times. Was drafted again September, 1918, and was put in general military service, although he was unable to raise arm above level of shoulder.

Has dislocated left shoulder about fifteen times in all. Was discharged May, 1919 for the same disability. Right shoulder was dislocated for the first time about six weeks ago while the doctor was reducing the left under ether. Right shoulder has been dislocated three times.

Two operations on the left shoulder in the army—failures.

Open operation at Boston City Hospital in 1918 on the left shoulder—failure.

Shows very poor musculature throughout, but especially in shoulder and scapular region both sides. No diagnosis of progressive muscular atrophy can be established. Left shoulder all shot up with operative scars front and back. Some stiffness in abduction.

Admitted to this hospital April 12, 1920. April 16, 1920: Ether operation. F. J. Cotton. Through an anterior incision. Burrell operation was performed on the left shoulder for recurrent dislocation. Patient made uneventful recovery. Discharged May 5, 1920, with advice that if dislocation continues in the right shoulder operation would be considered.

Examined March 7, 1921: Complaint: None. Function fair; musculature better; motion improved. No dislocation since. Right shoulder has not been out either.

Case XI.—J. O. G. Age twenty-five. Automechanic.

Diagnosis: Recurrent dislocation of right shoulder.

While in service (April, 1918) patient received dislocation of right shoulder. Had several recurrences. Admitted to hospital November 4, 1920.

x-Ray negative.

December 6, 1920: Ether operation. F. J. Cotton. Anterior incision made down to capsule of joint, which was found to be lax. Burrell operation performed.

Uneventful recovery. Active motion started in ten days.

January 3, 1921: Sling removed. Arm down to side. Physiotherapy started.

Examined March 7, 1921.

Complaint: None. No limitation of motion. Excellent result. At work at former occupation. No recurrence.[1]

Case XII.—S. A. L. Age thirty-three. Locomotive fireman.

Diagnosis: Recurrent dislocation of left shoulder.

While in service patient fell on extended arm, resulting in dislocation of shoulder. This was reduced, and has been dislocated on several occasions since. Patient admitted to this hospital November 6, 1920 for operation.

x-Ray revealed no pathology. Patient big, powerful, exceptionally heavy muscled about the shoulder.

November 9, 1920: Ether operation. F. J. Cotton. Incision was made in anterior surface of left shoulder along the anterior edge of deltoid muscle. Muscle retracted and capsule of shoulder exposed. This was found to be quite lax and Burrell operation was performed. Double sling applied. Uneventful recovery. Active motion started in two weeks.

Examined March 7, 1921: Complaint: None. No dislocation since. Has complete range of motion.

I have seen no cases of recurrent luxation following an original trauma in which there was any essential pathology save the loose capsule. No fractured glenoids, and only one case of flat small glenoid, in a boy whose first luxation was in his "teens."

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[1] April 6, 1921 an inquiry from the Federal Vocation Board's surgeon was received, asking if this man might take up automechanic's training, to which I felt safe in recording my assent.

There has been, I think, some confusion of mind produced by failing to distinguish these from the paralytic or obstetric cases of posterior luxation, which are practically never of honestly traumatic origin.

I confess I can see no sense in the muscle-shifting "stunts."

One may not argue as to the *permanence of cure* of any of these cases shown for another year perhaps, but they are good so far.

There was a fourth case in this series. He is at work 40 miles out of Boston and unavailable. This case was interesting because he was a huge, powerful chap, and to make sure I reefed in so much capsule that I limited his abduction and rotation so that it took him over six months to get back full free motion. He got it, however, and now after a year the shoulder has not gone out.

Old Cases: Sternoclavicular Luxation.—*Case XIII.*—J. R. K. Age twenty-one. Draftsman.

Diagnosis: Dislocation of sternal end of left clavicle with partial loss of function of left arm from injury received in France in April, 1918, when buried by explosion of shell.

Admitted to hospital July 14, 1920.

Examination negative except for conspicuous up and inward dislocation of sternal end of left clavicle, which is freely movable. x-Ray report July 28, 1920: Enlargement of left sternal clavicular joint with slight dislocation and apparently a small area present which would be consistent with a piece of loose cartilage in the joint.

July 29, 1920: Operation by F. J. Cotton. Joint cartilage loose; removed, and joint suture set in through drill holes in both bones across inside of joint. Close suture of anterior capsule. Uneventful convalescence. Discharged from hospital September 8, 1920. Improved.

Examined March 7, 1921.

Cured. Full function. Almost no deformity. Very little thickening.

Old Cases: Arthroplasties.—Arthroplasties are anything from excisions to joint reconstructions. If one gets perfectly free motion it usually is at the price of instability. Whether one uses an insert, Allison-Brooks "silverized" ox trachea fascia, as here, or the autogenous fat flap I have usually contented myself with, or nothing at all, is perhaps not so important as we used to think. Such operative technic as gives the briefest postoperative reaction, and therefore the earliest chance for motion, is a very important item.

Case XIV.—J. F. B. Age twenty-six. Occupation: Steamfitter's helper.

Diagnosis: Old gunshot wound of left elbow, involving end of humerus, ulnar, and radius. Ulnar nerve severed completely.

Wounded in action September 29, 1918 in France. Left elbow. Treated in France and at Camp Devens, Massachusetts. At old No. 10 Hospital had nerve suture performed (F. J. Cotton), with anterior transplantation. Admitted to this hospital on account of complete bony ankylosis of the left elbow, with paralysis of the ulnar nerve. Much improved, and still improving, but not cured. Arthroplasty has been postponed deliberately to give time to get clear of latent sepsis and for physiotherapy treatment to loosen scars and better the nutrition.

Ether and operation July 29, 1920, F. J. Cotton. Incision was made down to the bone of elbow, which was found to be completely ankylosed. Ulnar nerve was isolated and carried temporarily to one side and bone forming ankylosis completely excised. Lower end of humerus was trimmed off, forming blunt wedge. Ulnar and radius trimmed off to form loose-fitting joint. A piece of Allison-Brooks' membrane was fastened about lower end of humerus. Tissues closed and arm put in plaster cast at right angle.

August 18, 1920 cast was removed. Wound clean and healed; wearing sling during the daytime and cast at night. Patient receiving physiotherapy treatment. Motion was gradually restored, until (March 7, 1921) patient shows almost complete restoration of normal function, a good deal further advanced than before this last operation. Ever since operation the *working* use of fingers much better.

Flexion full. Extension full. Rotation 75 per cent. Lateral instability slight, perhaps 15 degrees of motion laterally.

Case XV.—H. M. Age twenty-six.

Diagnosis: While in service received gunshot wound of right elbow, causing compound fracture of radius and ulna. This resulted in severe sepsis. Patient is also suffering from epilepsy following kick by horse in 1917.

Admitted to this hospital February 3, 1920. Ankylosis of right elbow, arm held at 95 degrees flexion.

November 22, 1920: Ether and operation. F. J. Cotton. Arthroplasty without insert.

Examined March 7, 1921: Flexes to 80 degrees. Extends to 130 degrees. Rotation 50 per cent. Motion still improving.

Case XVI.—T. J. K. Age twenty. Occupation, student.

Diagnosis: Old gunshot wound of lower third of left leg.

June 21, 1920: Admitted to this hospital, complaining of pain and stiffness in left ankle aggravated by walking or standing.

Examination reveals long linear scars over both mesial and lateral side of left lower leg and small scar over tendo achillis, dorsiflexion about 30 degrees short of a right angle, foot held in equinus. Patient gives history of having had osteomyelitis and gas bacillus infection. Received Dakin treatment for five months. Had several sequestra removed from fibula and a secondary closure done at Baltimore January, 1919. Healed nicely, but with a marked equinus, probably due to prolonged use of splint without support of fore-foot.

Patient was seen by Dr. Rogers and tenotomy of tendo achillis performed without relief of equinus. Obstruction was bony.

September 29, 1920: Ether and operation. F. J. Cotton. Plastic excision of left ankle performed. Leg put up in plaster of Paris.

Examination March 7, 1921: Is wearing leg ankle brace with joint at ankle. Dorsiflexion limited at 95 degrees. Plantar flexion at 110 degrees. Walks with cane, limp still considerable, with some pain.

This Case XVI did not get as good a result as hoped for or as good as he is going to get eventually, but the method of handling an equinus deformity is perhaps new. This was a case in which tight scarred tissues all across the back of the ankle made soft tissue cross-cuts or plastics useless—as demonstrated. He had an equinus so extreme as to make him a cripple.

The operation was a temporary removal of the internal malleolus, and the preparation, with a "pattern-maker's" chisel of $1\frac{1}{4}$-inch radius, of a new tibial surface $\frac{3}{4}$ to $\frac{7}{8}$ inch up, to fit the curve of the astragalus. The fibula was then shortened to fit, a section being cut away just *above* the joint level. The internal malleolus was then sutured in place (Fig. 369).

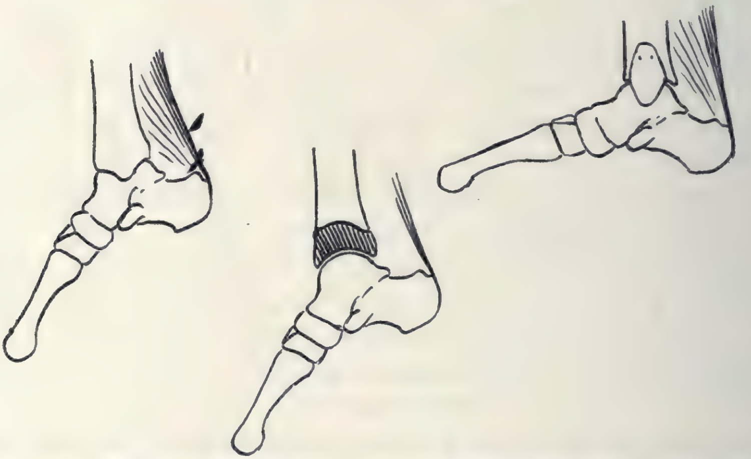

Fig. 369.—Diagrams of three stages of arthroplasty for contracture in Case XVI.

Old Case: Old Tarsal Fracture; Equinovarus Deformity.—*Case XVII.*—D. O'L. Fracture of bones of feet, right, 1917. Result of fall into a trench. Admitted November 23, 1920. Shows very marked talipes equinovarus. Weight carried clear out on to outer side of foot. Large framed, muscular man, in good condition. Attempt made to correct the deformity by plaster. Not successful. Referred to F. J. Cotton January

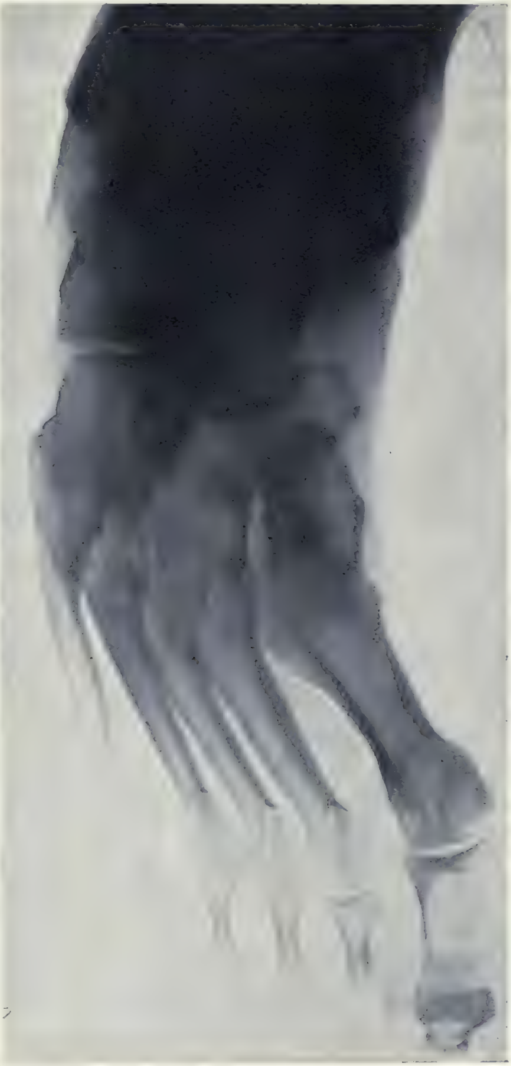

Fig. 370.—Case XVII before operation.

13th. Operated on January 29th. Incision in longitudinal line of foot just below the scaphoid about 2 inches long. Vertical incision of scaphoid. Forcible correction of deformity. Fragment of scaphoid kept apart by driving in a wedge graft from the tibia. In this way a very serviceable lengthening of the foot was obtained. Up on crutches February 26th. March 7th *x*-ray in plaster shows almost complete correction. Boot with upright ordered.

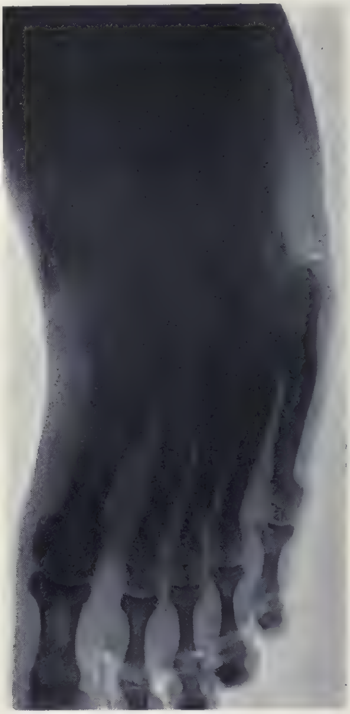

Fig. 371.—Case XVII after operation. Wedge in the split scaphoid.

This seems to be a very much better way, if one can do it, than to do a cuneiform osteotomy on the outer side of the foot, at best a destructive operation, shortening the foot and necessarily lessening its spring. In the case here cited there seems no reason why this foot in time, with a bit of care, isn't going to be as good as new (Figs. 370, 371).

Old Cases: Compound Fracture of Both Legs. Major R. W. Browne, Dr. W. F. Cotting.—*Case XVIII.*—F. C. Age thirty-two. Employee of Boston Navy Yard. Stevedore. Admitted to hospital August 12, 1920.

Diagnosis: Fracture of right clavicle, simple. Compound, comminuted fracture of both tibiæ.

Present history: While working at Navy Yard on August 12, 1920 was struck by a coal cable, which broke, and wound itself around patient's legs.

Fig. 372.—Right leg. Case XVIII.

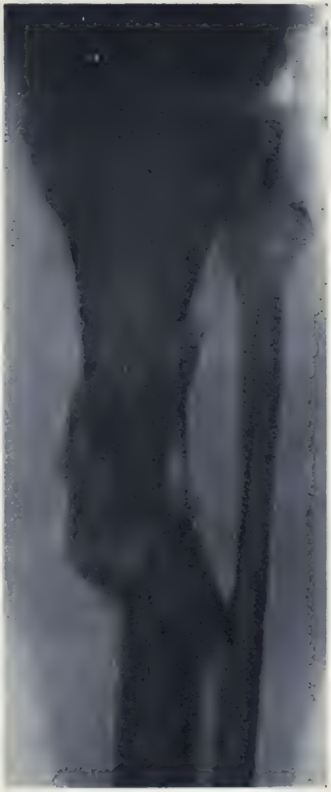

Fig. 373.—Left leg. Case XVIII.

Physical examination negative except for following: On admission patient in considerable shock. An abrasion on right shoulder, fracture of right clavicle. Compound comminuted fracture of both bones of both legs.

Modified Sayre dressing for fractured clavicle. Wounds of leg cleaned, cauterized with 95 per cent. carbolic. Fractures manipulated, and plaster-of-Paris cast applied (Figs. 372, 373).

x-Ray report August 14, 1920: Comminuted fracture of both tibiæ at upper third. Fracture involves 6 inches of each. Position good. Right fibula—a transverse fracture at junction of middle and upper third. Position good. Left tibia has an oblique fracture at upper third. Position fair. Transverse fracture of right clavicle. Good alinement.

Uneventful convalescence except for slight temperature on first ten days.

September 8, 1920: Small fragment of bone removed from right leg. Left leg has been entirely healed for one week. Physiotherapy started. Right leg slow in healing. Occasional piece of loose bone removed from wound.

Discharged improved January 7, 1921.

Examined March 7, 1921. Walks without crutch or cane. Excellent result. Union solid.

Old Cases. Pseudarthroses: Bone-grafts.—It is to be noted that the cases of pseudarthrosis lately coming to this service are not comparable to those of civil life. Dating back in nearly all cases to 1918, septic for months, already operated on to secure union once or several times without success, they show wide defects of bone and ill-nourished bone-ends to a discouraging extent; no one is going to get *consistent* good results on this material.

Case XIX.—J. H. Age thirty.

Machine gun bullet wound of left humerus. October 28, 1918. Admitted July 22, 1920 with flail joint in humerus, about 3 inches of tissue gone, but this loss partly taken up by soft tissue retraction. Partial musculospiral paralysis persists.

Operation August 4, 1920: Usual anterior incision, excision of scar tissue, denuding and squaring of ends. In this case the soft tissues, very redundant, were well cleared and pushed out of the way. A graft about 3½ inches was cut from the left tibia near, not on, the crest, was set solidly into the remains of the medullary cavity below, and then the upper end, previously sharpened to a stake, was driven home by blows of a heavy wood mallet on the elbow, the soft parts being held out of the way with retractors. Kangaroo tendon through lateral drill holes helped secure against slipping out and the arm well fixed, but right short was put up in plaster in sharp forward abduction and the patient kept a week in bed to let gravity help in retention. On account of the nerve lesion a cock-up splint also applied to the wrist. There was no reaction.

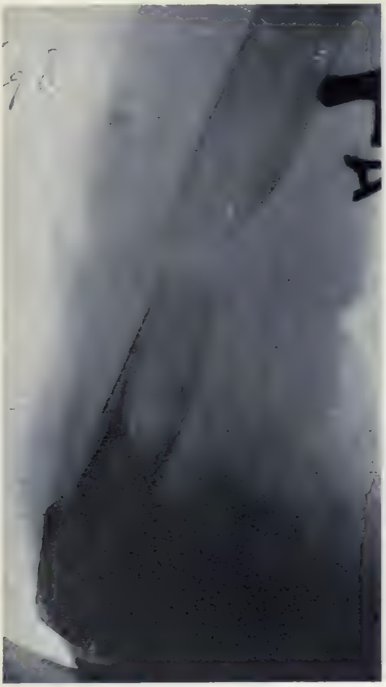

Fig. 374.—Case XIX. Pseudarthrosis before operation. Note the even, finished-looking cortical layer over the bone ends.

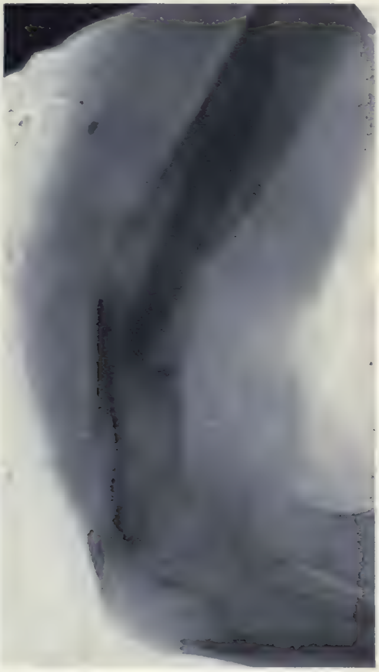

Fig. 375.—Case XIX. Bone-graft union. Clinically solid.

Examined March 7, 1921: Shows solid union, a much shortened, but useful arm. Nerve lesion apparently entirely recovered (Figs. 374–376).

Case XX.—J. M. Age twenty-eight.

Shrapnel wound 1918. Compound fracture of right humerus; much loss of bone. Operated by Cotton in 1919 in United States General Hospital No. 10 for closure of sinus. In spite of prompt closure he was advised to wait nine months or more for later operation on the bone (Fig. 377).

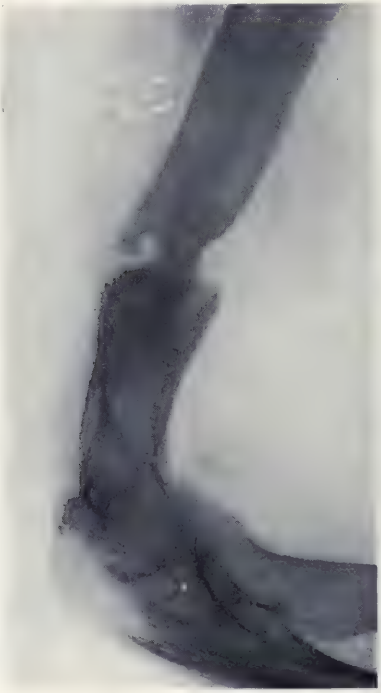

Fig. 376.—Case XIX. *x*-Ray at seven months.

Admitted January, 1921 with loose flail arm. No nerve lesions. Upper fragment short, shoulder-joint mobile within small range, elbow motion good. Long heavy scar about 12 x $\frac{1}{2}$ inches on back of arm. Scarring in front not extensive. General condition good.

Operated on January 21, 1921: Long anterior incision from near coracoid down the front of the arm, fragments exposed, ends cleared, and trimmed square. No medullary cavity above.

Graft from right tibia near the crest, not the edge itself, about $3\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$ inches driven into the upper fragment and down into the medullary cavity of drill holes to keep ends from pulling apart. Arm put up in abduction on "aviation" splint. No reaction, prompt apparent union. Is being held in splints as a precaution; arm seems perfectly solid at six and a half weeks. *x*-Rays show fair bone formation (Fig. 378).

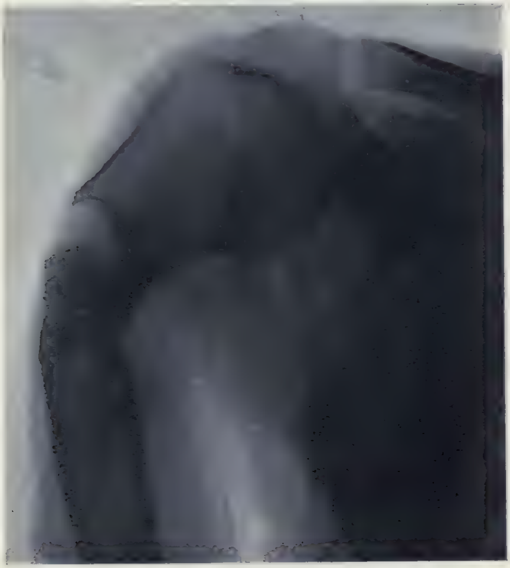

Fig. 377.—Case XX. Pseudarthrosis before bone-grafting.

Case XXI.—J. P. Age twenty-three.

Gunshot wound, October 15, 1918: Continuously under treatment since then. Bone-graft from tibia August, 1919. No union. March, 1920 I did a bone-"graft" with an intramedullary splint of boiled beef bone from the Hollister-Wilson laboratories, and cross-pinned the humerus with ivory pegs. No union. Graft broke some time after operation. There were never any nerve lesions, never severe sepsis. January 19, 1921 I operated again. By this time the loose pseudarthrosis had given way to a rather close one, function of arm not bad.

I had encouraged use of the arm in the interim, hoping to get better nutrition. The x-rays seemed to show success in this. The operation was as usual, with the insertion into the center of each end a graft cut from the tibia, and lashing the bones together with kangaroo. Limb put in abduction first in plaster of Paris, presently a "Cleary" splint in abduction. No reaction, but union very slow. Condition forty-five days later shows some apparent bony repair. There is still a trace of motion at the site of fracture, and I am by no means sure we are going to get bony union.[1] For the present, as a precaution, he is kept in an abduction splint.

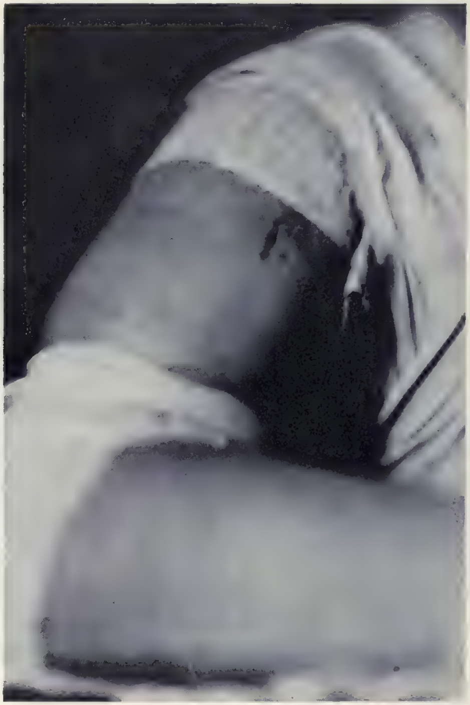

Fig. 378.—Photo of Case XX six weeks later.

Case XXII.—E. L. G. Age twenty-nine. April 11, 1918 arm broken as a result of fall. This fracture was compound,

[1] Since this was written apparently rigid bony union has occurred.

and the arm was operated on five different times before entry here. Operation September, 1918: Removal of necrosed bone. October, 1918 and November, 1918 attempted union of bone with sutures. June, 1919 intramedullary splint, beef bone. Still has a loose pseudarthrosis of left humerus, high up. Operative scars in plenty. Motions of upper fragment so much limited as to make preliminary operation necessary. Admitted November 29, 1919. Operated December 1, 1919. Plastic operation to remove axillary scar, to tenotomize the pectoral and latissimus and to mobilize the upper fragment. Physiotherapy treatment up to the second operation, January 24, 1920. Usual operation, graft from tibia. At ten days a portion of the wound quietly broke down; cleaned up under Dakin

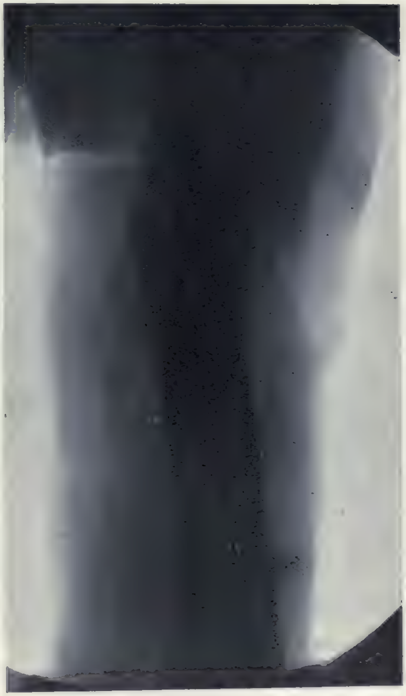

Fig. 379.—Case XXII. Old pseudarthrosis, very loose, two and a half months after bone-graft operation; looks promising.

solution promptly. Healed in about four weeks entirely. Splint continued. Discharged March 17th. April 15th slow increase in callus formation. Union not yet solid. June 9th still not solid. Is wearing small sleeve splint. Examined March 7, 1921, shows close fibrous pseudarthrosis, with very considerable improvement in function of arm. Not a solid union, but tending to grow closer with use rather than to loosen up (Figs. 379–381).

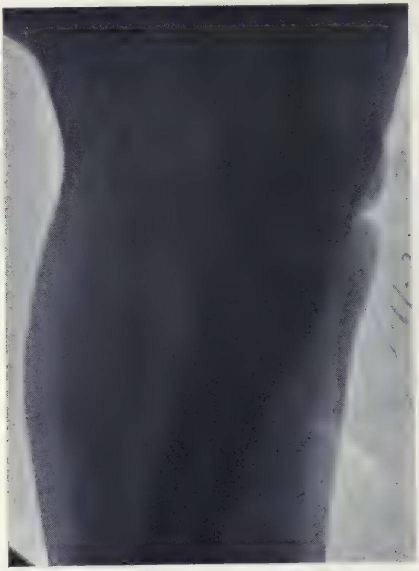

Fig. 380.—Case XXII. One month later; no new bone; pseudarthrosis shaping again.

Case XXIII.—Pseudarthrosis; tibia; bone-graft.

H. S. S. Compound fracture of left tibia, upper end, from motor truck accident. Osteomyelitis with eventual non-union, Has had a number of operations. Entered November 9, 1920. Fibrous union with marked loss of bone tissue just below spine of left tibia and consequent extreme bow-leg deformity. Fibular head displaced up and out.

November 15, 1920: Operation. Incision—denudation of fragments and freshening and trimming up of all fracture surfaces. Fibula not touched. Very forcible stretching into position as near a straight leg as may be. Bone-graft from tibia of other side, about $\frac{1}{2}$ x $\frac{1}{2}$ x $\frac{1}{4}$ inch, set and wedged in between fragments with limb on a stretch, and straightened graft held firmly by the elasticity of tissues. Plaster. Fitted out March 1, 1921 with retention apparatus—lateral steel uprights.

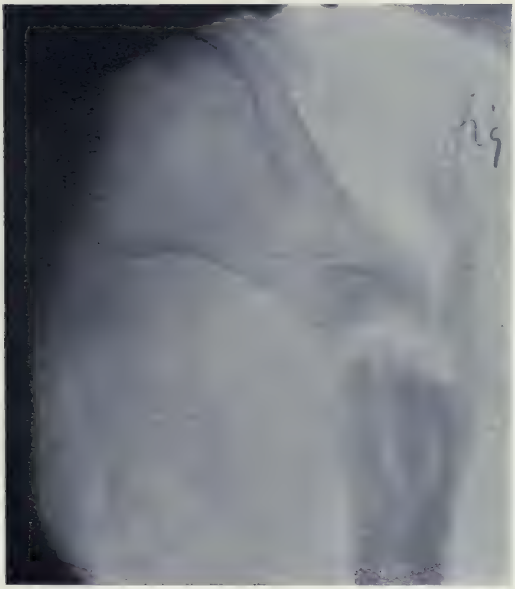

Fig. 381.—Case XXII. Seven weeks later. Pseudarthrosis complete; total failure as to bone union, though with a more useful arm.

Up and about; union not yet fully solid, but very promising, nearly certain, I think, but likely to need some apparatus protection for security for some months to come.

Old Cases. Fracture of Forearm: Malunion.—*Case XXIV.* —J. S. Admitted January 5, 1921. Age twenty-two. Injured by propeller blade June 5, 1915 at Fort Sills, resulting finally in loss of part of right hand, outer side, and third and fourth fingers on the right hand. Compound fracture of bones of forearm on left. Shows extensive scarring of the arm and a fracture of both bones bent down and in, to an angle of not less than 50 degrees. A good deal of disability as far as the hand is concerned, largely due to the mechanical disadvantage of the angulation. Operation advised. Operation carried out February 12th. Excision of massive scar over and about the radius. Division of radius, which was solid. Shortening of same, with rabetting of the ends to a length that gave a straight ulna, there being a pseudarthrosis of the ulna. Developed an infection. Definite, though never very severe, culture showing Staphylococcus albus. Still in hospital. Cleaning under Dakin treatment. Wounds not healed, but with no active infection and with union already beginning. In spite of the technical misfortune, result is apparently going to be good.

Old Case. Compound Fracture of Humerus; Osteomyelitis; Massive Sequestrum; Notable Reproduction of Shaft.—*Case XXV.*—P. C. G. Age twenty-five. Occupation: Printer.

Diagnosis: Old gunshot wound resulting in FCC of humerus, ulnar and radius, and upper end of humerus, right arm.

July 25, 1918, while in action at Chateau-Thierry, patient was struck by high-explosive shell, causing fracture of humerus, ulnar and radius, also of the upper end of humerus. Patient was treated at field hospital ten hours later, where amputation was advised. Patient refused amputation and Dakin treatment was instituted. This was continued until November, 1918.

x-Ray showed at this time regeneration of bone, and on operation 9 inches of humeral shaft was found to be sequestrated. This was removed and arm put in extension in Thomas arm splint, with Dakin treatment. Operation was performed by Lieutenant Dunn, of Minnesota, Johns Hopkins Unit.

When splint was removed patient had about 50 per cent. of elbow motion, and on being transferred to the States a plaster cast was applied. On arrival in the States the plaster was removed and elbow found to be completely ankylosed. Numerous sequestra were removed from elbow region.

On January 3, 1921 patient fell on subway stairs, causing fracture through callus at elbow. Was treated at this hospital; arm in plaster cast.

Examined March 7, 1921: Fracture repaired; elbow still ankylosed; shaft solid; no sinuses (Figs. 382–384).

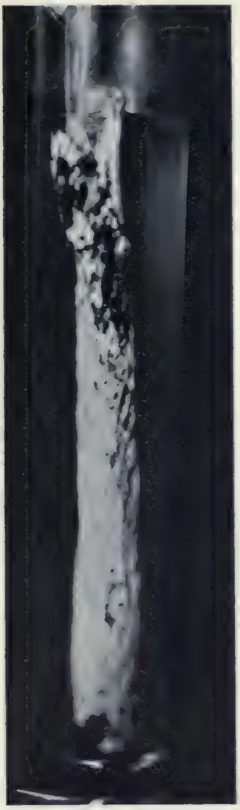

Fig. 382.—Case XXV. Nine-inch sequestrum of shaft of humerus.

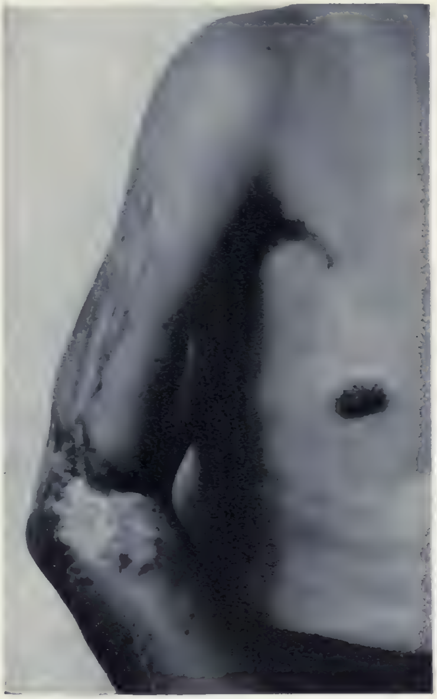

Fig. 383.—Case XXV. Photograph at present date.

Old Case. Jaw Fracture with Deformity.—*Case XXVI.*—G. R. C. Age twenty-five. Carpenter's helper.

Diagnosis: Fracture of inferior maxilla, simple, right side.

Admitted to hospital April 26, 1920.

Past history: On July 5, 1918 was struck by butt of rifle at naval bayonet practice and received a fractured jaw. The diagnosis was not made until three weeks after injury. Apparently no treatment at any time. Since then jaw has bothered him considerably, and he has been unable to masticate on that side since injury. Front teeth do not meet within an inch. Deformity very disfiguring, face one sided, mouth open.

Fig. 384.—Case XXV. *x*-Ray at present date.

x-Ray shows complete fracture of the right mandible, lower, starting behind teeth, running down and back to angle.

April 30, 1920: Patient operated on by Dr. Cotton and Dr. C. C. Cole, dentist. Open osteotomy performed on fractured lower jaw. Teeth were wired.

May 8, 1920: Teeth rewired by Dr. Cole.

Uneventful convalescence. Discharged July 29, 1920. No complaints.

Examined March 7, 1921: Only fair occlusion, but teeth meet, jaw solid.

Old Case. Ulnar Nerve Suture.—*Case XXVII.*—J. F. D. Age twenty-one. Occupation: Teamster.

Diagnosis: Gunshot wound of left forearm, resulting in nerve paralysis.

In July, 1918, while in action, patient was struck by shrapnel in left forearm. Was treated at base hospital, where median nerve was sutured. Admitted to this hospital November 8, 1920. Examination at this time showed typical picture following ulnar paralysis. Fingers contracted, considerable atrophy and vasomotor changes.

Patient was seen by Dr. Cotton, who advised suture of ulnar nerve.

Ether and operation: F. J. Cotton. Incision was made and ulnar nerve found. There was no actual division found, but the nerve was considerably atrophied and shortened. Nerve was transplanted anteriorly to the internal condyle of the humerus. Pad of fat was swung from the subcutaneous tissue and wrapped about the nerve. Wound closed with silkworm-gut.

Patient made uneventful recovery. Wound healed. On December 8, 1920 physiotherapy started, active and passive motions, resistive exercises, whirlpool bath, and Bristow coil. Banjo splint applied. Motion slowly returned in fingers, sensation practically the same.

Has been treated by P. T. Dept. up to this date.

March 7, 1921: Fingers extended. Nerve regenerating. P. T. daily and splint.

Old Case. Neuromata of Stump: Excision; Alcohol Injection.—*Case XXIX.*—O. I. Auto accident in France, 1918. Injury to right arm, followed by amputation. Painful stump of right arm, for which he was admitted August 10, 1920. In detail the painful areas in the stump are neuromata of the musculospiral, of the median, and ulna respectively, about

¾ inch back from the stump end. August 11th stump was opened up, these neuromata exposed, 60 per cent. alcohol injected into nerve trunks well back of the neuroma, and these trunks cut ½ or ¾ inch behind the neuroma mass. Seen and discharged July 17, 1920.

Examined March 7, 1921: Stump still sensitive, but not extremely so. No sign of redevelopment of neuromata.

Last year's work of Dean Lewis on the effect of alcohol infiltration in lessening neuroma formation seems conclusive,[1] and such infiltration should, to my mind, be a part of the routine in every amputation or re-amputation.

Old Case. Scar Excision. Two-stage Flap-graft.—*Case XXX.*—T. V. T. Civil service employee. Age thirty-one. Comes to hospital for surgical treatment of contracture of second, third, and fourth fingers of left hand, resulting from an injury in the palm of the hand July, 1916. Has been variously treated, including operation for transferring of free graft from thigh, which was not successful. Fingers so contracted as to be of little use. Operated on January 19, 1921. Two-stage plastic from abdomen to palm, and after dissecting out of a rather massive scar involving all the flexor tendons of the palm as well as superficial tissues. Graft left attached and hand hitched to abdomen for ten days, when graft was out half-way through. Dissection completed on eleventh day. Is still getting physiotherapy treatment and exercises to get back motion of fingers. Is very nearly ready to have an operation for thinning the somewhat redundant graft. Massage and active motion now being supplemented with banjo splint. He has a sufficient amount of covering for the palm of hand without much contracture. Prognosis good.

In 1918 in an article in the Military Surgeon[2] the use of these two-stage grafts for *lengthening* unhealed stumps was discussed. In reconstructional work they have a world of use. They are easy to do after one gains a facility, the lack of which somewhat impairs one's first dozen cases of the sort.

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[1] Not so sure later, but the procedure still part of my routine.

[2] Cotton: Military Surgeon, 1918.

Old Cases. Tuberculosis of Palmar Tendon Sheaths.—*Case XXXI.*—C. G. O'C. Age twenty. Occupation: Silk hose knitter.

Diagnosis: Tuberculosis of flexor synovial sheaths, left wrist.

Chief complaint: Pain and swelling of flexor surface of left wrist. About January 1, 1919 developed pain and swelling along flexor tendons of left wrist. Received various treatments, but none seemed to be of any benefit until November, 1919, when he was discharged from service. Was unable to work at his former trade on account of the above symptoms.

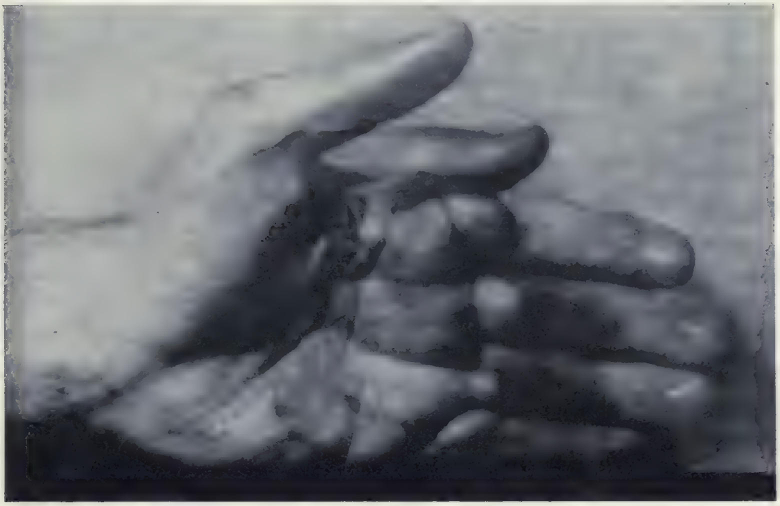

Fig. 385.—Case XXXI. Tuberculosis of tendon sheaths of wrist. Photograph showing condition and range of motion at present date. Two exposure plate—extension and flexion.

Admitted to this hospital May 24, 1920, and at that time showed typical symptoms and physical findings of a chronic teneosynovitis of flexor tendon sheath. Was seen by Dr. Cotton and diagnosis made of tuberculosis. Operation advised.

June 15, 1920: Ether and operation. F. J. Cotton. Complete excision of synovial lining of flexor sheaths of wrist and palm. Sheath was found to be filled with rice-bodies.

Wound healed by first intention and motion started early.

Physiotherapy given and patient obtained full function in a few weeks. During the operation it was found necessary to remove portion of flexor tendon of little finger on account of tuberculous involvement. On account of this patient is unable to flex little finger. Was operated on and distal end of fifth flexor tendon attached to tendon of the fourth. Function gradually returned and patient presented very satisfactory hand. Was discharged from hospital, and since then returned on account of recurrence of symptoms. Was operated on—opening made down to flexor tendons and a few rice-bodies expressed. A through-and-through irrigation of 7 per cent. iodin was made through wound in palm. It was found necessary to repeat this procedure at a still later date. In spite of this operative procedure patient has been able to maintain practically full function of hand.

Examined March 7, 1921: Wound healing. Nearly closed.[1] Function still excellent (Fig. 385).

Old Case. Tuberculosis of Tarsus.—*Case XXXII.*—H. McS. Age twenty-five.

Two years ago, following sore throat, had swollen neck gland, which continued to grow worse up to seven months ago. Gland in left axilla became enlarged in 1918. February, 1919 some of the glands in the neck broke down and were lanced. Since then gradually condition has slowly improved. About a year ago patient sprained right ankle, hurt it again four months ago. Some lameness since. On admission, January 26, 1920, showed considerable neck glands still and glands in the left axilla. A few in the right. Apparently tubercular, but not active. Blood, 4,668,000 red, 7300 white; 80 per cent. hemoglobin. Hodgkin's question decided in negative. *x*-Rays of ankle February 3, 1920 show no pathology in bone. Treated conservatively with physiotherapy for some time, and from March on had treatment with *x*-ray. *x*-Rays March 2d showed doubtful process of upper left and right lobes. Transferred to surgical April 5, 1920. Pain in right foot and swelling increasing. Some improvement under rest. Abscess on dorsum of foot opened March 31, 1920. x-Ray showed osteomyelitic process. Wound discharging. On April 21st x-ray showed increased bone destruction. April 24th curetage. Drainage. Dakin solution. May 13th x-rays showed improvement clinically, soft parts condition getting worse. Sinus remained open till August 10th, when he was transferred for operation. August 11th all diseased area cleaned out. Put up in cast. September 10th very little improvement as far as bone condition goes. Dakin continued. October 15th another sinus formed. From this time on grew slowly worse rather than better. Amputation considered. November 9th amputation of right foot point of election. Clean healing. Ideal stump. December 21st report on foot, guinea-pig inoculation, positive tuberculosis. At time of this operation patient had glandular mass in the left axilla, which was operated on January 14, 1921. Positive tuberculosis again. Report of J. H. Wright January 23, 1921. Examined March 7th: Good stump. Has been discharged from hospital with artificial leg. Has returned to substantially normal general health from condition of much emaciation and weakness.

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[1] June 27, 1921, solidly healed, function perfect.

This is not the first case in which I have fooled away unnecessary time in trying to save a tubercular tarsus in an adult.

Old Case. Cancer of Floor of Mouth.—*Case XXXIII.*—J. F. H. Age sixty-nine. Occupation: Cook.

Diagnosis: Epidermoid carcinoma, floor of mouth.

March 18, 1920: Piece of tissue of tumor in floor of mouth removed and sent to laboratory for bioscopy. Report was epidermoid carcinoma.

April 2, 1920: Ether and operation, F. J. Cotton.

Complete excision of tumor from floor of mouth, including a bit of the base of tongue on right; cautery to wound. Secondary acute infection of glands in submaxillary region followed.

Excision of glands of neck advised at later date. Meanwhile concentrated radium treatment by Dr. C. Wheland, with subsidence of said glands.

December 1, 1920: Block dissection of right submaxillary triangle of neck performed on this date. Uneventful recovery.

Examined March 7, 1921: No recurrence anywhere.

A difficult case because the man is enormously stout, thick necked, and with none too good a heart. It would have been advisable to do the left side of the neck as well, of course, but his condition became such as to make this too risky. It is doubtful if there were ever any malignant glands. No malignancy in those removed.

Old Case. Stomach Ulcer.—*Case XXXIV.*—J. A. S. Age thirty one. Laborer.

Diagnosis: Gastric ulcer.

Patient gives story of stomach trouble dating back to September, 1918. While in service in France had symptoms as follows: Nausea, gas, heart-burn and water-brash, coming on soon after meals. Was relieved by soda. Distress was usually relieved by vomiting, coming on after meals. Never noticed any blood. *x*-Rayed in France. Diagnosis: Probable gastric ulcer.

Admitted to this hospital July 19, 1920.

x-Ray examination negative for ulcer. Treated by Medical Surgeon until October 6, 1920, when he was transferred to Surgical Department for exploratory laparotomy.

October 6, 1920: Ether and operation. Dr. Cotton. Posterior gastro-enterestomy was performed. Ulcer on gastric edge of pylorus; stomach opened and explored; crater of ulcer about $\frac{3}{8}$ inch. Walls moderately heaped up, not hard; pylorus not actually involved.

October 7, 1920: Patient had a very poor night, vomited large amount of blood. Pulse rapid and weak; 1000 c.c. saline solution given subpectorally. Patient grew progressively weaker. Blood transfusion done at 9.30 P. M. Citrate method used; 750 c.c. given.

October 8, 1920: Patient's condition much better except for an abscess of the abdominal wall, which was opened and drained. Patient's recovery was uneventful.

Examined March 7, 1921: Complaint, none.

Gained 40 pounds since operation.

Case interesting because my exploration of the ulcer undoubtedly stirred up the very serious bleeding.

Old Case. Hemolytic Jaundice: Splenectomy; Complete Recovery.—*Case XXXV.*—J. J. S. Age twenty-seven. Lieutenant of Coast Artillery.

Diagnosis: Splenic anemia.

Admitted to this hospital March 2, 1920.

Family history negative. Past history unimportant except for malaria six years ago.

Present illness: Has been in several hospitals with diagnosis of splenic anemia. Eighteen months ago had a sharp severe pain in left side, immediately following which patient became intensely jaundiced.

This jaundice persisted for two weeks before improvement began.

Chief complaint: Weakness, drowsiness, feels lazy and sluggish at all times. Sleeps a great deal, but can be easily aroused. Cerebration rather slow. Patient complains of difficulty in concentrating. No vertigo, syncope, indigestion, nausea, vomiting, constipation, or diarrhea. Has had frequent persistent nose-bleeds during past six months.

Eyes: Right pupil larger than left, but both are regular and react to light. Movements normal. No nystagmus. No strabismus. Sclera and skin show slight jaundice. Physical examination negative except for abdomen, which is extended, non-tender except over spleen, which reaches downward to umbilicus and inward to median line. Firm, rounded, no notch felt. Liver palpated 2 cm. below costal margin on deep inspiration.

Blood picture: Blood examination made by Dr. R. C. Larrabee. Hemoglobin 61 per cent. R. B. C., 3,500,000. Color index, .87. Platelets, 300,000. Slight achroma. Moderate poikilocytosis. Reticulated reds 16 per cent., normal about 1 per cent.

Diagnosis: Probably acquired form of hemolytic jaundice. Splenectomy advised.

May 28, 1920: Splenectomy under ether by F. J. Cotton.

Uneventful convalescence except for temperature the first three days after operation of 100° F. Jaundice cleared up and patient up and about the ward June 17, 1920. Blood picture normal July 12, 1920.

Discharged improved August 17, 1920.[1]

Old Case. Undescended Testis.—*Case XXXVI.*—E. S. S. Age twenty-five. Machinist's helper.

Diagnosis: Hernia, inguinal, indirect, right.

Patient states that he never had any trouble before entering the army. First time that he complained was on the boat going to France, October, 1918. While lifting a heavy bale he got a stitch in the right groin. Was examined by a doctor, who said he had a hernia.

Admitted to this hospital December 2, 1920.

Examination reveals undescended right testicle. Impulse felt through inguinal ring. Ether and operation December 27, 1920 by W. F. Cotting.

Right inguinal incision made and tumor mass found opposite internal abdominal ring. This was opened into, and by traction testicle of normal size and consistency was delivered. Testicle was replaced within the abdominal cavity, internal ring closed with chromic gut. Bassini herniotomy was performed.

Patient made uneventful recovery. Developed small stitch in three weeks, which cleared up under treatment.

Patient was discharged relieved December 27, 1920.

A few weeks ago local doctor called up hospital and made report that patient was suffering from left inguinal hernia, and in great pain. Patient was admitted to this hospital and examination revealed left epididymitis. Patient gave story of Neisser infection and diagnosis of G. C. epididymitis made. Epididymotomy was performed and epididymitis found to be extended with pus. This was relieved by multiple stab wounds and tunica drained.

Uneventful recovery.

Hip. Gunshot Wound. Compound. Old. Conservative

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[1] Reported to me as entirely normal in blood picture, by Dr. Buckman, June 25, 1921. Seen by me June 10, 1921, and entirely normal to gross examination, and in vigorous health.

Treatment. Result.—*Case XXXVII.*—E. M. Age thirty-five. Occupation: Nurse.

Diagnosis: Arthritis, acute (suppurative), right hip-joint.

P. I. Ambulance case from Lynn Hospital, where he was treated for "rheumatic fever." In August, 1917 patient reported sick with backache. Relieved by aspirin. Has had occasional attacks of vague pains in back and joints of arms and legs since. Three weeks before this sickness he had pain in knees and ankles. Then developed pain in right hip and was unable to walk. Since confined to bed. Fleeting pains in joints.

Admitted June 1, 1920.

Right hip slightly swollen. Is painful to touch and motion. Some pain in left shoulder and a decided limitation of motion due to pain. Joint not swollen.

Right leg in abduction. Foot everted, pelvis tilted, apparent shortening. Acute hip spasm, etc.

x-Ray negative.

June 3d: Seen by Dr. M. W. Rogers. "Acute hip. Severe type. Probably not T. B. Advised traction. To consider operation." W. B. C. 6000. Temperature normal to 100° F.

June 5th: W. B. C. 13,300. Wassermann negative. Traction, with relief.

June 14th: Operation by Dr. Rogers. Pus found in hip-joint, wick inserted. Plaster spica and Bradford frame. Culture: Streptococcus pyogenes.

June 20th: Wick out. Wound draining small amount.

July 7th: Patient sitting up.

July 15th: Crutches. Cast off.

September 14th: Short spica to relieve pain.

October 20th: Cast off. Crutches. Examination shows improvement. Very slight muscle spasm.

November 1st: Short spica.

January 6, 1921: *x*-Ray; irregular outline; femoral head and acetabulum.

February 23d: Transferred to Convalescent Home.

Salivary Fistula.—*Case XXXVIII.*—O. V. R. Age thirty. Occupation: Longshoreman.

Diagnosis: Salivary fistula resulting from gunshot wound of left side of face.

On June 18, 1918, at Chateau-Thierry, while in action, patient was struck by fragment of high-explosive shell.

Admitted to this hospital and operation performed to close salivary fistula, under ether. Incision was made into the little sac existing behind the fistula in the parotid gland, and a ureteral catheter was inserted from within the mouth, through Steno's duct to the fistula, and into the opened pocket in the gland, running from gland. Fistula excised. Tissues sutured over catheter in three "shingled" overlapping layers. Tube was removed after several days and artificial duct was found to be functioning. Following this treatment patient's only discomfort was a small area inside of cheek, which remained unhealed. This was cureted and finally healed.

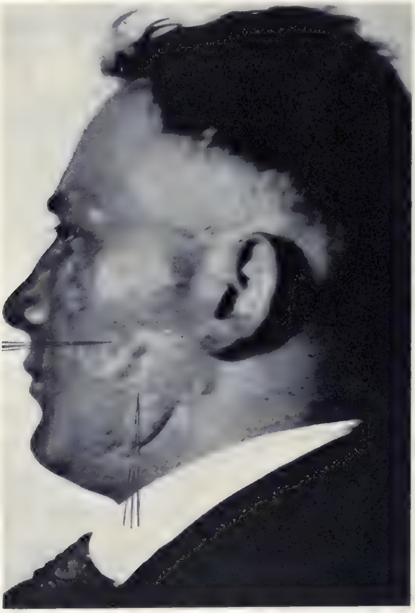

Fig. 386.—Case XXXVIII. Healed salivary fistula. Fistula was at intersection of the lines sketched in.

Examined March 7, 1921: Cured (Fig. 386).

This is not a usual method, at least, of dealing with these fistulæ. Here there was no proximal end to the duct at all to put through the cheek to the mouth. Steno's duct is not hard to catheterize, but I was doubtful how well an indwelling catheter would be tolerated. There was no trouble and only the least leakage, and, oddly enough, apparently never any tendency to stricture.

Case XXXIX.—Brain wound; aphasia; grafting for skull defect.

J. C. A. September 12, 1918 received gutter wound of left parieto-occipital region, with dural and brain penetration of fragments. Conscious. No sign of paralysis, but unable to talk; vomiting; pulse 54; blood-pressure 130/75/55. Wound, transverse, tangential, left occipital region, measured 10 by 4 cm., ragged edges of torn scalp; exposed brain with evident loss of brain substance. Roentgen ray report: No foreign body in brain. Indriven fragments of bone, left occipital region. Foreign body (high explosive), 18 by 10 mm. in lower end of right tibia.

Neurologic findings: Aphasia. When asked when he was wounded, answered "tonith." Recognizes objects, but is unable to call their names properly. Unable to write name, though he spells his name J-O-H-N as he attempted to write it. Loss of muscle sense in right hand (is right handed). No loss of sensation to pinprick right or left. Slight weakness (emotional) right side of face. Right-hand grip weaker than left. Pupils dilated, but equal. Abdominal, epigastric, and cremasteric reflexes absent right and left. Babinski reflex present right, suggestive left. A complete right homonymous hemianopsia.

Operation September 12, 1918 (twelve hours): Pulse had come up to 80. Novocain-epinephrin after $\frac{1}{3}$ gr. morphin. Block removal of bone, débridement of brain by suction with removal of numerous bone fragments and considerable contused brain substance. Edges of dural wound, 2 by 1.5 cm. excised. Two bleeding points tied. Scalp closed with interrupted silkworm-gut. No drainage.

Wound of leg dressed; removal of shell fragment.

September 13th: Pulse 100. Tries to talk, but unable to call objects by their proper names. Eye-grounds normal.

September 14th: Pulse 80. Able to say a few words.

September 15th: Aphasia slightly improved.

September 17th: Aphasia improving. Hemianopsia the same.

So far from notes of Mobile Hospital No. 1. Dr. C. E. Dowman.

From Mobile No. 1 went through three hospitals till he came to Brest. November 11th returned on an army transport to Newport News, thence to a base hospital, and on December 7th was discharged to report in Boston.

He was found by friends in Boston, entirely lost, totally aphasic, and taken in an ambulance to United States Army General Hospital No. 10.

At this time his aphasia and agraphia were complete, he was confused, worried, and apparently suffering from severe headaches, mainly about the wound. The wound was not only wide and pulsating, but on coughing or stooping the brain contents bulged over an inch through the opening, restrained but little by the thin, soft covering of scalp. Such bulging was painful and increased his discomfort and mental confusion.

After prolonged rest he improved, began to be able to make semi-intelligible answers, and at least thought connectively for short periods. The hemianopsia subsided. There were periods of painful numbness and weakness of the right arm, but never any real Jacksonian symptoms. The agraphia remained complete. He was put in charge of a special aide to oversee his education, and she, by patient effort, brought him to a point where he could talk intelligently and write fairly well, though he tired easily as a result of physical or mental tension, and had mental processes very distinctly slowed.

Also there were persistent dizziness and headaches, and because these things were troublesome and in some part at least due to the irritation of the in and outgoing brain in the big gap in skull and dura, I decided to roof in the skull.

This was done in August, 1919, under ether, sections of a rib (his rib) being used, split on the flat, and each piece grooved at the ends to fit the sharpened skull edge, and sprung and "swedged" tightly into place and covered in with the scalp. No opening was made into the scarred but flexible dural tissue.

There was a little mental reaction after the operation, but within a fortnight he had returned to the same condition as before, save for a very decided improvement as to headaches and dizziness.

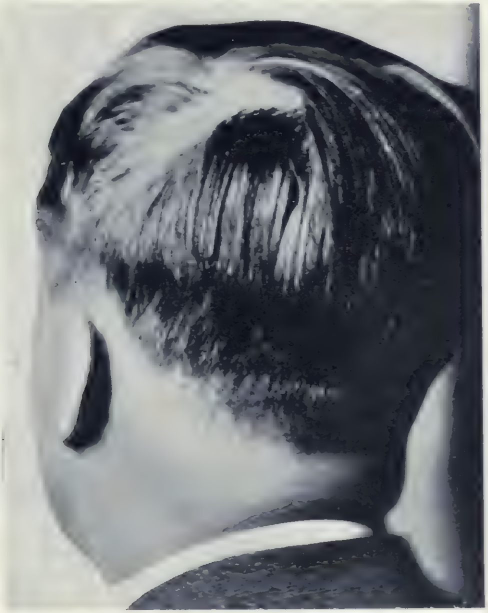

Fig. 387.—Case XXXIX. Repair of skull by bone-grafts from rib.

Since then he has improved, and today is normal in appearance and in conduct, can speak clearly, and shows only a certain slowness of thought and speech. He still tires easily and has been unable to go on with a technical training, for which he is very eager. Fatigue and excitement or emotion accentuate the hesitation of speech, and if extreme bring back the aphasia in part, and at times the numbness and weakness of the right arm and hand. There is no hemianopsia. Headaches are not severe or frequent. There apparently are no symptoms referable to brain pressure. No disturbance referable to the wound. The scar pulsates over a very small area at the lower corner. Otherwise the skull is solid, the grafts having "taken" and grown, their rib curve just about matching that of the skull (Figs. 387, 388).

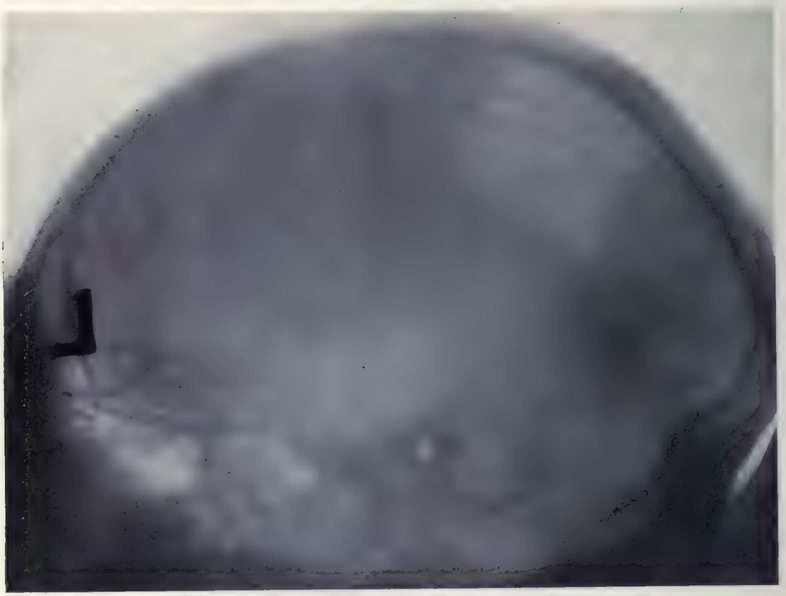

Fig. 388.—Case XXXIX. Rib-grafts in defect of skull solidly healed in place.

Case XL.—J. F. L. Laborer. Age thirty-three. Tuberculosis of knee; excision.

In 1919 without trauma began to have slight trouble in standing and knee swelled. Suddenly worse after a slight bump. Luetic history, but treated. On entrance (June 14, 1920) showed muscle atrophy, knee in flexion, swollen, hot, slightly reddened, not very painful, but almost entire loss of motion. Synovial thickening considerable. *x*-Ray shows a good deal of bone destruction. Diagnosed as tubercular. (Charcot joint excluded.)

October 6, 1920: Operation. Type excision with fixation by slender ivory pegs. Cast. A typical excision, but with an extraordinary amount of synovial proliferation and destruction.

In spite of this, save for a little leakage for a fortnight or so, beginning at six weeks, the course has been uneventful.

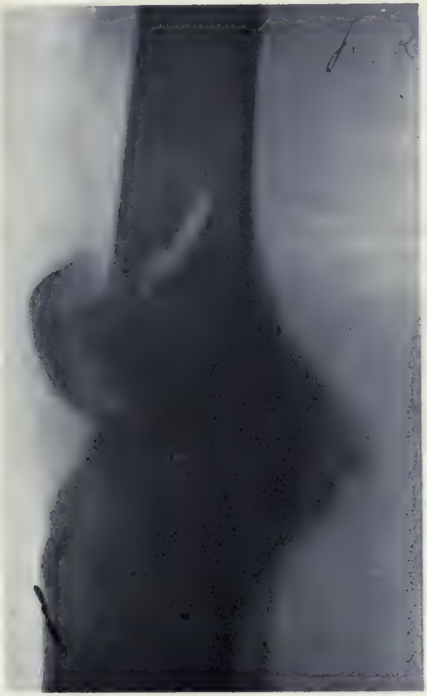

Fig. 389.—Case XL. Excision of knee for tuberculosis. Condition at three months.

He has now a solid knee, left nearly straight, because a good bit of bone removal gave shortening and because he is a laborer with no sitting to do, professionally at least (Fig. 389).

Case XLI.—Os calcis fracture; remodeling with mallet.

J. H. Foundry molder. Age fifty-three.

Fell downstairs. Entered February 16, 1921.

Fracture of the common compression type, of the left os calcis. Examination showed the usual broadening, out beyond the plane of the external malleolus in this case. Lateral motion much limited. Crepitus on motion. x-Rays showed usual picture.

February 22, 1921: Ether. Remodeling of the os calcis, particularly a shoving home of the heavy projecting outer plate into its place under the outer malleolus. For this a heavy mallet is used with the foot rolled inward over a sand-bag. In this case the remodeling went well. Then the lateral motion, having been cleared fairly well by rocking motions, the foot was put up in plaster with pad pressure below the external malleolus.

Three and a half weeks later the cast was removed and motion begun. He began to walk at four and a half weeks, and now shows little deformity and very fair lateral motion, no flat-foot, not much pain. The result should be a useful foot, even if less springy than normal. Without remodeling we should have had a foot locked against lateral motion, with steady pain from pressure of malleolus on the outgrown calcis—a crippled foot.

CLINIC OF DR. DAVID CHEEVER

PETER BENT BRIGHAM HOSPITAL

TUBERCULOSIS OF THE MAMMARY GLAND

THIS patient (I. G., Surg. No. 13,988) presents a condition probably more common than is generally supposed, and correspondingly more important. She is a Jewish woman, thirty-seven years of age, married, who has had 3 living children, the youngest one year ago. Her family history shows no tendency to familial disease. Her past history is one of uninterrupted good health. Her first two babies, born thirteen and ten years ago, were nursed for many months without any incident. The third baby, born one year ago, was nursed for about four and a half months, when the left breast began to be tender, swollen, painful, and red. She says it was incised by her local doctor, with evacuation of pus; the drainage continued for about three weeks, by which time the wounds were healed. Soon afterward the patient noticed a hard lump in the upper and outer quadrant, which was sometimes the seat of stabbing pains. She consulted several doctors without obtaining relief, and four months ago was an inmate for one week of a neighboring hospital, where hot applications gave relief from pain. Since then, and more especially during the last two months, she has noticed that a more definite mass has developed, of increasing firmness, but without much pain. There has been no discharge from the nipple, and the old incisions have remained healed. Recently she was seen in our Out-door Department, and was at once recommended for admission. Before discussing the diagnosis let us make an examination.

There is no need of lingering over the general physical examination except to say that it shows a woman in apparently perfect health except for the affected organ. Both breasts are large, full and pendulous, and the right is actively lactating, and normal in other respects. The left breast is distinctly larger than the right and of generally firmer consistency. It is more full in its upper and outer part, and palpation shows a hard firm induration, which, when the breast is picked up from the chest wall, makes a mass the size of a small fist. It is not tender. Its periphery is ill defined and shades off somewhat gradually into the surrounding tissue. The skin overlying it is not reddened, but is distinctly immobile over the underlying mass, and when an attempt is made to pinch it up it presents the familiar pig-skin appearance. There is no increase in surface temperature. The nipple, which she states was formerly normal, is retracted nearly out of sight, and shows no discharge. The scars of three small incised wounds, well healed, are noted below the nipple, in no relation to the mass. Examination of the axilla and the base of the neck fails to show enlarged lymph-nodes.

What is the diagnosis? Consider again that a woman of thirty-seven presents a hard, insensitive mass in the breast, of some months' duration, increasing in size, with depressed, adherent overlying skin and retracted nipple! We would be criminally negligent if we did not consider first carcinoma, and it was with this presumptive diagnosis that the patient was instantly referred for admission for exploration. The characteristics which seem to be inconsistent with carcinoma are indeed few. The mass is not quite so hard as the usual carcinoma, especially of the scirrhous type. Its periphery appears to be unusually vague. It seems unusual not to find axillary metastases in connection with so massive a growth. Its occurrence during lactation, and appearance after the drainage of a breast abscess, suggests that it may be a persistence of pyogenic infection, but certainly the long duration and the absence of most of the usual signs of inflammation seem to rule this out. The patient's temperature and leukocyte count are normal. Above all things, we must not allow our minds to be diverted from carcinoma simply because the process began in a lactating breast which is so commonly the seat of suppuration. Cancer of the lactating breast is not infrequent, grows with great rapidity, and is usually of the rather soft medullary type, conforming in many respects to the characteristics of the case before us. The diagnosis is often missed because it is mistaken for an inflammatory condition, until the only possible hope of cure of this horribly fatal lesion is lost through delay.

What other diseases of the breast must be considered in diagnosis? It resembles no other neoplasm, unless possibly sarcoma, which is relatively rare, constituting probably not more than 2 or 3 per cent. of breast tumors, and is usually circumscribed, nodular, and rapidly growing. While sarcoma may occur in most varied gross and histologic forms, we have no especial reason to suspect it here, and, after all, since the treatment would be the same there is no need of attempting to differentiate it with certainty from carcinoma. A syphilitic gumma must be considered, and a Wassermann test should have been made as a routine to exclude it. Gumma of the breast is rare, and if it had existed as long as the present lesion and reached its size, it would almost certainly have broken down. In a woman who gives no history of lues and shows none of its stigmata, this rare tertiary form can be ruled out. Actinomycosis occasionally attacks the breast, very rarely as a primary invasion, usually as an extension from an intrathoracic lesion. Tuberculosis must be considered. Other diseases, such as sporotrichosis, attack the breast, but are so excessively uncommon that as a practical matter they do not deserve serious consideration.

Having considered the diagnosis and admitted its uncertainty, we are fortunately in no doubt as to the proper course to pursue. We must first obtain the patient's unqualified consent to whatever operative procedure, however extensive, we may find to be necessary. This precaution is absolutely essential in women where there is the slightest possibility of the necessity of removal of any of the pelvic organs or of the breast. It is a great shock to a woman to realize that organs peculiar to her sex have been removed—that child bearing is impossible.

She may have wished for no more children, and may have expressed annoyance at the discomforts attending menstruation, yet the passing of these functions represents to her the transition from youth to age, and may be bitterly resented. For somewhat similar reasons the mutilation or removal of the breast is peculiarly shocking. Failure to obtain explicit consent may involve the surgeon in recriminations or even in litigation.

After the usual preoperative preparation the patient is anesthetized, preferably with nitrous oxid gas and oxygen, an incision is made into the most characteristic part of the lesion, and a small piece removed for immediate frozen section and diagnosis by a competent pathologist, and the wound instantly cauterized, preferably by the actual cautery or, if this is impossible, by some powerful escharotic agent. It is not justifiable to postpone the final operation until the tissue can be sent to some distant laboratory for examination. If immediate histologic diagnosis cannot be made, it is wiser to rely on the experienced surgeon's knowledge of gross pathology, or to send the patient to some clinic where the facilities are adequate.

In the case of our present patient the incision shows normal breast tissue interspersed by firmer fibrous-like areas, and others of soft, pale, friable tissue. One or two small pockets containing a drop or two of thick pus are encountered. Immediate examination of this pus shows no organisms, and histologic study of the tissue by frozen section is returned by the pathologist with the diagnosis of a chronic inflammatory process showing giant cells and no evidence of neoplasm. Our suspicions of tuberculosis are at once aroused by this combination of chronic inflammatory tissue containing giant cells and bacteria-free pus. Unfortunately, the definite diagnosis of tuberculosis cannot be made from a frozen section, for we know that giant cells may be expected in any chronic process where nature is attempting to destroy and absorb noxious material; it will require more elaborate technic, the preparation of paraffin sections, and perhaps the inoculation of a guinea-pig.

The proper procedure now is to remove the breast cleanly and explore the axilla, but, unfortunately, the patient has insisted that the whole breast shall not be sacrificed except for malignant tumor. Fortunately, by excising the upper and outer quadrant of mammary tissue, we can remove apparently completely the affected tissue, and examine the axilla, whose lymph-nodes prove to be normal. The breast is quite satisfactorily reconstructed by buried plain catgut sutures, and the skin is closed with silk, leaving a small drain of protective gutta-percha tissue in each angle. We shall advise a massive radiation of the breast and axilla with *x*-rays as a prophylactic measure, because this, in our experience, has a distinct therapeutic value in tuberculous adenitis.

Contrast this case with that of this other patient (Mrs. G. R. F., Surg. No. 14,295). She is a young married woman twenty-three years of age, who has always been, and still considers herself to be, exceptionally healthy. She has one child living and well at the age of four years. She has never been exposed to tuberculosis. Six months ago she noticed the spontaneous appearance of a small lump in the left breast, below the nipple, without coincident pain. Four months later, after having been poulticed for three weeks, the lump enlarged somewhat, opened spontaneously, discharged, and subsided considerably, leaving a small granulating area. Two weeks later the swelling reappeared, and two other superficial ulcerations have developed and persisted. At times there is a sharp pain over the swollen area. The patient has noted no discharge from the nipple and no glandular swelling in the axilla.

Physical examination shows an exceptionally healthy appearing young woman whose only other deviations from the normal are hypertrophied tonsils and a few carious teeth with pyorrhea. The left breast is slightly larger than the right. The nipple is not retracted. The skin is normal except that about 4 cm. below the nipple is a group of three very shallow ulcerative lesions, each surrounded by an area of purplish congestion. The edge of each ulceration is undetermined and irregular, the base varies from a pink to a gray color, and subjacent to it is a thickening of the tissues which individually does not amount to much, but collectively with the others forms a conspicuous mass when the breast is picked up from the chest wall. This mass is not tender, but the small ulcerations are exceedingly sensitive if touched. The skin elsewhere over the mass is not adherent. There is no sinus or deep discharge. The pectoral group of axillary nodes shows that several are slightly enlarged, rather soft and insensitive.

Here is a lesion not difficult of diagnosis. It has none of the characteristics of tumor. The sensitive, shallow ulcers, with irregular, purplish, undetermined borders, overlying a thickening of breast tissue, suggest one of the chronic granulomata. The Wassermann test is negative and there is no luetic history, so that a gumma can be excluded. Moreover, stained scrapings and fluid from one of the ulcers have shown acid-fast bacilli consistent with those of tuberculosis. We are perhaps surprised, as in the first case, that the patient is in such vigorous health, but, as a matter of fact, we know that peripheral tuberculosis is not necessarily accompanied by debility.

We will proceed by the same method as before. Under gas-oxygen anesthesia an incision is made through the base of one of the ulcers and a piece removed for diagnosis, the incision being at once cauterized. Dr. Wolbach reports that examination of frozen sections shows giant cells consistent with tuberculosis, and he is willing to make that diagnosis, although stating that giant cells may be found also in simple chronic mastitis. Certainly the sum of our evidence justifies the diagnosis without the demonstration of bacilli in the tissues by finer histologic methods, or guinea-pig inoculation.

The breast is removed by an elliptic incision beginning over the tendon of the pectoralis major, opening up the axilla from which the areolar tissue and fat is removed *en masse* with the mammary gland and the pectoral fascia. The most important thing in connection with the incision besides the affording of proper access to the lesion, is the preservation of the axillary flap of skin, which insures perfectly free motion at the shoulder-joint, especially in abduction. The outer end of the incision must be kept in front of the anterior axillary fold, lest in healing and contracting it may become a "bow-string" across the hollow of the axilla and limit abduction. When healing is complete prophylactic *x*-ray treatment will be advised, as in the first case.

What is the source and course of the infection in these two healthy women? Mammary tuberculosis is classified as primary or secondary, and no especial interest attaches to the latter, for there is nothing unusual in the extension of the disease to the breast from neighboring structures such as the pleuræ, ribs and cartilages, sternum and lungs, though it is less common for the breast to be involved in a wide-sperad infection disseminated by the blood. Primary mammary tuberculosis, on the other hand, presupposes the entrance of the organism directly into the breast, or at some distant point without forming a local lesion, and the passage of the organism by the blood- or lymph-stream to its final nidus. The breast is rather liable to injuries, and infection may enter through abrasions of the skin or about the nipple. In the first patient the existence of lactation undoubtedly favored such injury. Here also must be admitted the possibility of infection through the lactiferous ducts. An infant partly nursed and partly bottle fed might contract bovine tuberculosis and transmit it to the mother in nursing. But in this patient undoubtedly the most plausible theory is that the occurrence of a simple acute pyogenic mastitis with incision and drainage afforded the opportunity for a secondary tuberculous infection. Theoretically, the possibility must be admitted of the entrance of a tubercle bacillus through the tonsils, or a carious tooth, or through some lesion of the respiratory or gastro-intestinal mucosa and its transference to the breast by the blood-stream, without any intermediate period of development. In a given case such a condition could only be proved by a complete autopsy. As a practical matter we may class any case as primary in which no coexisting focus can be discovered at the time, or develops soon after.

Deaver and MacFarland,[1] writing in 1917, review the cases in the literature and accept a total of 90 reported since 1881, when the diagnosis first began to be certified by reliable microscopic examination. In addition to the 2 cases which we have been considering, 2 others of primary tuberculous mastitis have occurred in the Peter Bent Brigham Hospital which may be referred to briefly.

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[1] Deaver, J. B., and MacFarland, Joseph: The Breast, its Anomalies, its Diseases, and their Treatment, Philadelphia, 1917.

Miss E. E. H., twenty-one years of age, single, colored, Surg. No. 5002, admitted July 3, 1916. A lesion of the left breast appeared following trauma. General physical examination failed to show evidence of tuberculosis. No involvement of axillary nodes. A partial resection of the breast was done; microscopic examination showed tuberculosis. The wound healed *per primam* except for a small area, and she was discharged with this clean and granulating.

Mrs. D. K., thirty-six years of age, married, white, Surg. No. 4983, admitted July 1, 1916. Spontaneous appearance of a tender lesion in the non-lactating breast seven weeks ago; incision with persistent sinus. General physical examination failed to show any evidence of tuberculosis elsewhere. The breast was cleanly removed. Histologic examination showed tuberculosis. Healing was *per primam* and she was discharged well.

These 4 cases of primary mammary tuberculosis have occurred among a total of 228 surgical diseases of the breast admitted since January, 1913, and operated on. This is an incidence of about 1.7 per cent., which compares with less than 1 per cent. reported by Deaver and MacFarland, and 1.3 per cent. reported by Scott.[1] It seems likely that with more accurate diagnostic measures the percentage of cases of tuberculosis among patients with benign lesions of the breast will be found to be larger than we have supposed.

[1] Scott, Sidney: St. Bartholomew's Hosp. Rep., 1905, xl, 97.

PEPTIC ULCER AND GASTRIC NEUROSIS

Here are 2 patients whose cases are completed, and afford a most useful contrast in diagnosis.

Mr. J. J., fifty-five years of age, married, Surg. No. 13,990, presents a perfectly normal family and previous personal history. He is an industrious man, a woodworker, supporting his wife and 2 children. Twelve years ago he began to have moderate epigastric discomfort coming on two or three hours after eating, with eructations of gas and watery material. This group of symptoms came in recurring periods, lasting perhaps a month, with intervals of several months of well being. No nausea or vomiting. Seven years ago he had a sudden faint turn, was taken home, regurgitated small amounts of "coffee-ground" material, passed large dark stools, and felt unaccountably weak. Recovery was prompt, and he has gone on much as before. until about eight weeks ago, when the symptoms became somewhat worse; he is apt to lie awake at night on account of the pain. Recently he has felt faint and weak. Two weeks ago he vomited a small amount of "coffee-ground" material, and again a week ago. The pain is more severe than formerly and has no especial radiation. The epigastric region is said to be sore to the touch when the pain is severe. No relief is obtained by ingestion of food or soda. The appetite is good, but for a year he has limited his food to bread and milk and fried bacon, which seem to agree with him. He gets on better if he does not overload the stomach. His bowels are regular, without catharsis, and he has noticed nothing peculiar about the stools. He thinks he has lost 15 or 20 pounds in weight.

Physical examination shows a pale, debilitated looking man, who exhibits nothing abnormal except carious teeth and pyorrhea, and a rather low blood-pressure. There is no tenderness, mass, or spasm in the epigastric region, which reminds us that unless a gastric or duodenal ulcer is close to complete perforation we do not expect to get local signs. The general physical examination of patients with ulcer may be perfectly negative. Gastric analysis is somewhat unsatisfactory on account of stasis, but the presence of at least a normal amount of acid is established and the benzidin test for blood is negative. The stools are normal except for a positive benzidin test. The blood examination is consistent with a moderate degree of secondary anemia; urine normal. Fluoroscopic examination after a barium meal shows that at the end of six hours but little of the barium has left the stomach, which is normal in position, size, and contour, with deep peristalsis. This examination is repeated after giving the patient belladonna, and shows that the sphincter has relaxed somewhat, allowing a small stream of barium to pass through the pylorus into the duodenum. There is no filling defect about the pyloric end of the stomach. The studies suggest a non-malignant lesion involving the first portion of the duodenum and the sphincter.

The diagnosis of this patient's trouble presents no difficulties, with certain reservations. Each method of reaching a conclusion is supported by the next. The history of twelve years of epigastric discomfort and indigestion, occurring in periods of exacerbation and remission, the onset of pain two to three hours after eating, the tendency of the pain to occur at night, the instinctive limitation of food by the patient to bland substances which do not excite the secretion of acid, the story of regurgitation of a substance consistent in appearance with altered blood on three occasions, and the passage of tarry stools, are almost pathognomonic of ulcer situated near the pylorus. We miss, it is true, the usual story of relief brought by eating and by taking soda, and might expect nausea or vomiting to be more conspicuous. The physical examination does not help us, except in so far as the absence of palpable tumor or of enlargement of the liver constitute negative evidence of the existence of well-established malignant disease. The gastric analysis reveals the existence of marked stasis, and the presence of a high normal amount of hydrochloric acid. There is no gross or occult blood, to which finding we attach little significance because we know that the ulcer may be situated beyond the pylorus and because a chronic ulcer may exist for long periods without hemorrhage. Moreover, if fresh blood were present, we should be obliged to consider traumatism by the tube as a probable cause. The fluoroscopic examination after the ingestion of barium gives concrete and visible evidence of a normal appearing stomach without filling defect due to tumor or crater due to ulcer, and without the persistent deep incisura of the greater curvature so characteristically present at a point opposite a lesion on or near the lesser curvature. There is nearly complete six-hour stasis, which is evidently not wholly due to pyloric spasm, as it is only partially relaxed by belladonna. There is some hypermotility which suggests an ulcer at or beyond the pylorus, but we must bear in mind that this finding is important only in the presence of hydrochloric acid, since anacidity alone may cause it.

Each of the three means of investigation—the history, the gastric analysis, and the fluoroscope—points to the same conclusion: a chronic ulcer at or near the pylorus, causing a considerable degree of obstruction. It is not profitable to insist on the differentiation between a prepyloric and a duodenal lesion, since the symptomatology and treatment may be exactly the same.

Before discussing the treatment of this case let us consider this second patient, who presents a somewhat similar picture. Mr. W. E. B., twenty-nine years of age, single, a steamfitter by trade (Med. No. 13,864, Surg. Nos. 13,073 and 13,991), has already been admitted twice to the hospital with the same complaint. His family history is good. His previous history reveals little that is significant, except an attack of typhoid fever at the age of twenty-one, and one attack of gonorrhea. There has been chronic constipation, worse during the last two years, and moderate loss of weight. He has used alcohol moderately, but occasionally to excess, he smokes 12 cigarettes daily, and drinks 6 cups of coffee and 3 cups of tea.

He entered the medical service six months ago complaining of pain in his stomach. Two years earlier he had noticed a tendency to headache, increasing constipation, and lassitude.

Nine months before his first admission he began to have pain in the upper abdomen a few minutes after eating, which lasted from half an hour to several hours; it was steady rather than colicky, did not radiate, and was unaccompanied by nausea, vomiting, or belching of gas. He has never taken soda. The pain was sometimes relieved by catharsis. He has eaten but little on account of the pain, and five weeks before entrance he quit work. On questioning, he said that he had passed blood by rectum and described tarry stools. He had been first seen in the Out-door Department, where *x*-ray studies showed nothing but slight gastric stasis, and a diagnosis of gastric neurosis was made. He was under observation for a month, during which he continued to complain of pain after eating, and he was finally admitted to the medical service.

Physical examination showed a rather apathetic man, with no noteworthy deviation from the normal except some sensitiveness in the epigastrium. His blood Wassermann reaction was negative, and on account of his headaches a lumbar puncture was made and neurosyphilis excluded by examination of the spinal fluid. The gastro-intestinal studies were repeated, and this time there were noted a somewhat hypertonic stomach, without six-hour residue, but with a definite irregularity of the duodenal cap. The entire gastro-intestinal tract showed hypermotility. Gastric analysis showed no stasis, absence of free hydrochloric acid in the fasting contents, and a low normal acidity after a test meal. The benzidin reaction was positive for blood. Several examinations of the stools showed a faintly positive benzidin reaction on one occasion only. A re-examination by barium and *x*-ray again showed a deformity of the duodenal cap.

A consultation with the surgical service was held, and the opinion was expressed that a duodenal ulcer existed with atypical history and symptoms. He was given a bland diet with alkalies after the manner of Sippey, his constipation was somewhat straightened out, and after five weeks he was discharged feeling much better, with instructions to continue these measures. The diagnosis was duodenal ulcer and chronic constipation.

Five weeks later, after observation in the Out-door Department, having showed no material improvement, he was admitted to the surgical service, but developed a boil in the epigastric region which precluded operation at that time, and he was discharged.

Five months later he was again admitted, with the story that in the interval his symptoms had been growing worse, the pain beginning immediately after meals and lasting two to three hours. His constipation was more marked. He had headache and dizziness. He had lost 10 pounds more in weight, was unable to eat or work, and desired operation if it offered a chance of relief.

Let us recapitulate this history and attempt a diagnosis: An unmarried man, twenty-nine years of age, seeks advice for a dull epigastric pain, coming on soon after eating, lasting a variable time, unaccompanied by nausea and vomiting, sometimes relieved by catharsis. He describes macroscopic blood and tarry material in the stools. He has had annoying constipation and headaches. Physical examination is negative except for slight epigastric tenderness. Gastric analysis has shown no stasis, a distinctly subnormal acidity, and a positive benzidin reaction. Stools have shown nothing remarkable. Barium and *x*-ray studies, made on three occasions, showed at the first examination nothing noteworthy, but at the two subsequent ones a definite deformity of the duodenal cap was noted. Neurosyphilis has been excluded.

What importance shall we attach to these various data? The history is certainly not at all typical of gastric or duodenal ulcer, but suggests rather the "bilious" type of individual, debilitated, possibly preoccupied with his own symptoms, since he has not much else to worry about. We regard a carefully taken history, analyzed conscientiously, as the most important means to a diagnosis of peptic ulcer. Nevertheless, we admit that the atypical case exists, if only to prove the rule. The physical examination here tells us nothing. The gastric analysis is strongly opposed to the diagnosis of ulcer. The positive benzidin reaction is of little value, because traumatism of the esophageal or gastric mucosa cannot be excluded. The hypo-acidity, amounting at one examination to an absence of uncombined acid, is strongly against ulcer, which is usually characterized by a high, or at least a normal acidity. Probably not more than 5 per cent. of ulcer cases show hypo-acidity. The *x*-ray examination is our stumbling-block. Negative at first, it has shown deformity of the duodenum on two subsequent occasions, and our roentgenologist has felt justified in making a diagnosis of ulcer. We have the greatest respect for this opinion, because the roentgenologic diagnosis of ulcer has attained astonishing accuracy. A persistent crater on the profile of the lesser curvature is practically pathognomonic of an ulcerative process, but without it, the finding of six-hour stasis and a persistent incisura on the greater curvature constitute important evidence of gastric ulcer, while gastric hypermotility and deformity of the duodenum are equally reliable evidences of a duodenal lesion. In this case the observation of duodenal irregularity is not much strengthened by the slight hypermotility, which may be accounted for by the hypochlorhydria.

We feel grave doubts as to the existence of an organic lesion in this case, and are inclined to place it in the class of neuroses. How much would our diagnostic problems be simplified if we had any accurate criteria of the neurotic temperament! One point in this patient's history we are inclined to emphasize, namely, the fact that he has reached his thirtieth year without marrying. It may seem far-fetched to associate this with a neurasthenic tendency, but we observe it so often that it is worth mentioning. The overwhelming majority of men of the working class marry, and usually marry comparatively young, and when this normal expression and fruition of a powerful physiologic instinct has not been sought, it argues the possibility of some neuropsychic deviation from the normal. This observation does not hold true, however, with the brain workers, where the intellect dominates the physical or somatic functions, and furnishes, to some extent, a substitute for their consummation.

These 2 cases have been operated on. The first patient showed a chronic indurated ulcer on the lesser curvature just proximal to the pylorus, which was not actually involved. There were extensive old adhesions fixing the pylorus and duodenum to the under surface of the liver and to the gall-bladder, which, with edema of the tissues and pyloric spasm account for the gastric stasis. The ulcer was excised with the cautery, the defect repaired, and a posterior gastrojejunostomy done. He is now, two and a half weeks later, ready for discharge, having had a normal convalescence. The operation has given him complete relief from ulcer pain; he is eating a more liberal diet than for years, and a fluoroscopic examination shows the barium passing almost entirely through the stoma. The second patient, on exploration, showed absolutely no organic lesion of the viscera, although each and every one of them was examined by sight or by touch. The pylorus and duodenum showed no irregularity or adhesion or change to account for the fluoroscopic findings. The appendix contained fecoliths, and was removed. Its histology was negative. The patient is convalescing normally and thinks he feels very much better. We shall emphasize the removal of the appendix, using it as a legitimate means of suggestion therapeusis. We regret a negative exploration, but in a case of this sort, after having exhausted every means to reach a diagnosis, we consider exploration justifiable and relatively harmless.

It is tempting, but impossible here, to enter far into the discussion of the relative merits of medical and surgical treatment of peptic ulcer. At one extreme stands the medical enthusiast, who believes that he can cure nearly every case by rest, diet, and the neutralization of gastric acidity, and that surgery is usually unnecessary, frequently ineffective, and sometimes fatal; at the other extreme stands the surgeon, who knows that he can operate on these cases with an almost negligible mortality, and with a very high percentage of permanent relief, who numbers among his cases a large number who have been for months or years in competent medical hands, and who occasionally finds at operation an early malignant process susceptible of radical cure. The accumulation of clinical experience and statistics will gradually permit a rational relative standardization of treatment. At present we feel that surgery offers the best prognosis in the treatment of chronic, indurated peptic ulcer, in the individual whose social circumstances will not permit the long-continued and elaborate régime which alone may be expected to effect a cure by non-surgical means.

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